ABSTRACTS OF NORTH AMERICAN GEOLOGY

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INTRODUCTION

Abstracts of North American Geology contains abstracts of technical papers and books and also citations of maps on the geology of North America including Greenland, the West Indies, as well as the State of Hawaii, Guam, and other island possessions of the United States. Articles of a general nature by North American authors are cited even though published in foreign journals, but those by foreign authors are included only if they appear in North American journals. Abstracts are prepared only of material that is believed to be generally available. Ordinarily abstracts are not published of material with limited circulations (such as dissertations, open-file reports, or memorandums) or of other papers presented orally at meetings.

The Abstracts will be an additional reference tool but will not replace the Bibliography of North American Geology, which has been published by the Geological Survey since 1887. Twelve monthly issues of Abstracts of North American Geology will be published each year. The Bibliography will include citations and subject index for a calendar year.

Abstracts of North American Geology and the Bibliography are being prepared by use of computer techniques. Each abstract along with its indexing is placed on magnetic tape and entered into a permanent data bank. The material prepared each month will be published in the form of the present issue. The abstracts are arranged alphabetically according to senior author. A subject index follows the abstracts and is designed for rapid reference to any subject desired. Bibliographies can subsequently be retrieved according to the terms used in the index.

The abstracts in this issue were prepared by Joan R. Clark, Georgianna D. Conant, Margaret Cooper, S. C. Creasey, D. L. Durham, G. D. Eberlein, Wanda L. Grimes, Andrew Griscom, B. C. Hearn, J. J. Hemley, J. W. Hosterman, W. P. Irwin, Virginia M. Jussen, Medora H. Krieger, Marie L. Lindberg, Elisabeth S. Loud, Mildred C. Mead, D. R. Mullineaux, Virginia S. Neuschel, E. H. Roseboom, R. W. Tabor, Dorothy B. Vitaliano, H. C. Wagner, W. S. White, F. C. Whitmore, Jr., E. W. Wolfe, R. G. Yates, and E-an Zen.

ABSTRACTS

2208 **Abu-Gheida, Othman M.** Effect of stress on ultrasonic wave velocities in rock salt [abs.]: Dissert. Abs., v. 25, no. 11, p. 6529–6530, 1965.

Adams, John W. *See* Staatz, Mortimer H. 2576

Addicott, Warren O. *See* Durham, David L. 2356

2586 **Addicott, Warren O.** Miocene macrofossils of the southeastern San Joaquin Valley, California, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-C, p. C101–C109, illus., table, 1965.

Marine mollusks referable to the principal divisions of the California Miocene chronology occur in the southeastern San Joaquin Valley. Early and middle Miocene assemblages occur in the Kern River area northeast of Bakersfield. The Baker's Ranch fauna of this area is the standard for the middle Miocene "Temblor stage." New data from current biostratigraphic studies in the Kern River area indicate that this important faunal unit ranges from near the base of the Olcese Sand to the top of the Round Mountain Silt. Middle and late Miocene macrofossils occur in the Tejon Hills near Arvin.—Author's abstract

2657 **Addinall, E.; Hackett, P.** Tensile failure in rock-like materials, *in* Symposium on rock mechanics, 6th, Rolla, Mo., 1964, Proc.: Rolla, Mo., Univ. Missouri, p. 515–538, illus., tables, 1964.

The use of established techniques to determine failure criteria associated with brittle materials (coal measure rocks in this case) under direct or induced tensile stresses is discussed. The information is of particular importance in defining the areas of ground in which fracture has taken place and where deformations are no longer in the elastic regime. Application of the Brazilian test, solid disc tests, and ring tests are described. Results indicate that no satisfactory test for "true tensile strength" has been found.—V.S.N.

2677 **Adler, Hans H.** Examination of mass-radius effects, hydrogen bonding and υ_h splitting in infrared spectra of Zr-Hf homologs: Am. Mineralogist, v. 50, no. 10, p. 1553–1562, illus., table, 1965.

Infrared absorption spectra of homologous hafnium and zirconium sulfate tetrahydrates refute the idea that vibrational frequencies of functional molecules in crystals are affected by the mass of the external cation. The frequency shift of the sulfate anion stretching modes is evidently caused by a slight change in ionic radius produced by cation distribution. The OH frequencies indicate hydrogen-bond formation. . . . The data indicate that cation substitution in isomorphous mineral systems may be expected to affect the strength of the H bond, the relationship being generally one of increasing H-bond energy with decreasing cation size.—Author's abstract

2209 **Akers, Ronald Hugh.** Unusual surficial deposits in the Driftless Area of Wisconsin [abs.]: Dissert. Abs., v. 25, no. 11, p. 6530, 1965.

2329 **Allen, C. R.** Transcurrent faults in continental areas, *in* A symposium on continental drift: Royal Soc. London Philos. Trans., ser. A, v. 258, no. 1088, p. 82–89, illus., 1965.

Transcurrent faulting appears to be a far more important tectonic process than has usually been recognized. Characteristic features of active faults, easily overlooked in the absence of aerial photographs, are enumerated. Most puzzling are the transcurrent fault zones of the circum-Pacific rim, where the relationship between major transcurrent faults of the continental margins and structures of the deep ocean floor is obscured. The Gulf of California appears transitional in that it combines many attributes of extensional rift valleys with those of transcurrent faults. Demonstrated movements in the circum-Pacific zone are largely parallel to continental margins and thus fail to fit neatly with most theories of orogenesis and drift.—D.B.V.

2435 **Allen, Walter Carl.** Solid solution in the refractory magnesium spinels [abs.]: Dissert. Abs., v. 25, no. 11, p. 6670, 1965.

2371 **Alverson, Douglas C.** Geology and hydrology of the Fort Belknap Indian Reservation, Montana: U.S. Geol. Survey Water-Supply Paper 1576-F, p. F1–F59, illus., tables, geol. map, 1965.

This report describes the geology and assesses the water-bearing potential of all aquifers on the Fort Belknap Indian Reservation, Mont. Ground water under water-table conditions is obtained at present from alluvium, glaciofluvial deposits, and the Judith River Formation (Cretaceous). Yields to wells are generally low but adequate for domestic and stock-watering use. The possibility of obtaining large supplies under artesian pressure is favorable near the Litle Rocky Mountains and under ground-water conditions in alluvial gravel of creeks issuing from these mountains.—W.L.G.

2317 **Alvord, Donald C.; Holbrook, Charles E.** Geologic map of the Pikeville quadrangle, Pike and Floyd Counties, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-480, scale 1:24,000, section, text, 1965.

Coal beds in the Pikeville quadrangle are largely common banded and have a wide range in thickness (28–60 inches); most coals have firm structure and fair to excellent blocking characteristics; and production is mainly from the Upper Elkhorn coal zone. Most gas production is from the Devonian Ohio Shale, the Mississippian Greenbrier Limestone, and sandstone units in the Mississippian Pennington Formation. Alluvium and bar deposits in the channels of streams contain large reserves of sand and gravel of potential use in general construction. Shale from the Breathitt Formation is a potential source of clay, and sandstone from the same formation has many uses.—M.C.M.

2466 **Am. Assoc. Petroleum Geologists; Soc. Econ. Geologists; SEPM.** (Pacific Sections). Geology of the southeastern San Joaquin Valley, California, Kern River to Grapevine Canyon, guidebook, 1965: [Los Angeles, Calif.] Am. Assoc. Petroleum Geologists, Pacific Sec., 40 p., illus., 1965.

The rocks range in age from Paleozoic metamorphic to Recent terrace deposits. Upper and middle Miocene megafossils are shown, and several geophysical field demonstrations are described. Five cross sections and a structure contour map on the Santa Margarita sand are included.—E.S.L.

2459 **Ambrose, J. W.** Memorial to James Edwin Hawley (1897–1965): Geol. Soc. America Bull., v. 76, no. 11, p. P175–P179, portrait, 1965.

Ames, H. T. *See* Kremp, G. O. W. 2671

2571 **Anderson, R. E.; Ekren, E. B.; Healey, D. L.** Possible buried mineralized areas in Nye and Esmeralda Counties, Nevada, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-D, p. D144–D150, illus., geol. map, 1965.

Recent geologic reconnaissance in the vicinity of Goldfield, Nev., has revealed the widespread occurrence of an upper Tertiary (Pliocene) ash-flow tuff sheet, the Thirsty Canyon Tuff, laid down on an erosional surface of considerable relief. Several topographically high areas that were not covered by the tuff sheet commonly contain hydrothermally altered and mineralized rock. At three localities adjacent to these areas it is likely that gold- and silver-bearing rock extends beneath, or lies in separate bodies beneath, the tuff or overlying alluvium. One of these localities is inferred from a gravity anomaly in Stonewall Flat.—Authors' abstract

2500 **Armstrong, C. A.** Geology and ground water resources of Divide County, North Dakota—Pt. 2, Ground water basic data: North Dakota Geol. Survey Bull. 45, pt. 2 (North Dakota Water Comm. Ground Water Study 6, pt. 2), 112 p., illus., tables, 1965.

The data in this report are useful for predicting subsurface conditions in Divide County; the depth and thickness of aquifers, water levels, and quality of water may be estimated for a given site by examining the tables and maps. Extrapolation based on these data should be conservative because of the irregular distribution of materials within the glacial drift. A summary of sources of data, the well numbering system, explanation of tables, quality-of-water data; and maps showing location of wells and springs, and of test holes and selected wells complete the report.—M.C.M.

Armstrong, Frank C. *See* Oriel, Steven S. 2518

2561 **Arnott, R. J.** Particle sizes of clay minerals by small-angle X-ray scattering: Am. Mineralogist, v. 50, no. 10, p. 1563–1575, illus., tables, 1965.

Particle sizes of clay minerals can be determined by means of intensity scattering at low incident angles; Maxwellian distribution of particle sizes and the particle shapes are assumed. Experimental equipment and method are described, and the results on several clay minerals show good agreement with previous size estimates arrived at by different techniques.—E.Z.

2427 **Ashbaugh, Alexander Cleveland.** An experimental study for the selection of geological concepts for intermediate grades [abs.]: Dissert. Abs., v. 25, no. 10, p. 5775–5776, 1965.

2688 **Attewell, Peter; Brentnall, David.** Attenuation measurements on rocks in the frequency range 12kc/s to 51kc/s and in the temperature range 100°K to 1150°K, *in* Symposium on rock mechanics, 6th, Rolla, Mo., 1964, Proc.: Rolla, Mo., Univ. Missouri, p. 330–357, illus., tables, 1964.

Using magnetostrictive methods, six rocks (two igneous, one metamorphic and three sedimentary) have been studied in the frequency range 12kc/s to 51kc/s at temperatures ranging from 100°K to 1150°K. During the high temperature tests, the specimens were confined within a narrow bore electrical resistance furnace, while at low temperatures cooling was achieved by means of liquid N_2. The results show that at room temperature, attenuation increases linearly with frequency but that a plot of attenuation against temperature within the above temperature band indicates several well-defined attenuation peaks. Some implications of these peaks are discussed.—Authors' abstract

Bachman, George O. *See* Dane, Carle H. 2326

2262 **Badgley, Kirk, Jr.** Rock Creek sapphire placers, *in* Geology of the Flint Creek Range, Montana—Billings Geol. Soc., 16th Ann. Field Conf. 1965: Billings, Mont., Billings Geol. Soc., p. 120–121, 1965.

Sapphire placers are located about 16 mi southwest of Philipsburg, Mont., in gulches tributary to the West Fork of Rock Creek. Productive placers range up to 10 feet in thickness and up to 200 feet in width. Extensive mining began about 1899 and continued intermittently until 1943. There are no commercial operations at present.—E.S.L.

2412 **Baile, R. A.** Some new concepts in geophysics [abs.]: Tulsa Geol. Soc. Digest, v. 32, p. 169–170, 1964.

2301 **Baird, David M.** Glacier and Mount Revelstoke National Parks—Where rivers are born: Canada Geol. Survey Misc. Rept. 11, 104 p., illus., 1965.

The first part of this guidebook describes in some detail the general aspects of the geology of Glacier and Mount Revelstoke National Parks, British Columbia. The rocks of the area and origin and shape of the mountains are discussed. The last part comprises a series of notes on what is to be seen at each of the viewpoints and roadside stops along the main travel routes.—E.S.L.

Baldwin, H. L. *See* Cushman, R. V. 2440

2151 **Ball, Douglas.** United States tar sands: Interstate Oil Compact Comm. Comm. Bull., v. 7, no. 1, p. 50–56, illus., 1965.

Tar sands, as defined here, include asphaltic and oil-impregnated limestones and other carbonates, and asphaltic conglomerates, siltstones, and clastics but not oil shales, or heavy-oil fields. They represent an important liquid fuel source, similar to the Canadian Athabasca tar sands which have been reported as the world's greatest liquid fuel reserve. The United States reportedly has from 2.5 to 5 billion bbl oil recoverable from surface and near-surface impregnated rocks. Oil companies have leased more than a million acres of tar sand land chiefly in Missouri, Kansas, Oklahoma, and California. More than 100 thermal oil recovery projects are in operation or being planned. Sands are plentiful in the Pacific Coast and Rocky Mountain States but absent in the Atlantic and Gulf Coasts and the Appalachians.—M.C.

2168 **Ball, Stanton Mock.** Stratigraphy of the Douglas Group (Pennsylvanian, Virgilian) in the northern Midcontinent region [abs.]: Dissert. Abs., v. 25, no. 10, p. 5857, 1965.

2423 **Barker, Fred; Brock, M. R.** Denny Creek Granodiorite Gneiss, Browns Pass Quartz Monzonite, and Kroenke Granodiorite, Mount Harvard quadrangle, Colorado, *in* Changes in stratigraphic nomenclature by the U.S. Geological Survey, 1964: U.S. Geol. Survey Bull. 1224-A, p. A23–A26, illus., tables, 1965.

Barnard, Walter M. *See* Wright, Harold D. 2673

Barnett, Paul R. *See* Staatz, Mortimer H. 2521

2420 **Barrett, Ed.** Origin of mobile belts—Ouachitas emphasized [abs.]: Tulsa Geol. Soc. Digest, v. 32, p. 175–176, 1964.

2526 **Bassett, William A.; Takahashi, Taro.** Silver iodide polymorphs: Am. Mineralogist, v. 50, no. 10, p. 1576–1594, illus., 1965.

Stability fields, and crystal structures of six polymorphs of silver iodide have been investigated by optical and X-ray techniques employing a high pressure diamond cell up to 200°C and above 100 kilobars. Two triple points have been fixed; one at 98±2°C and 3.1±0.4 kilobars and the other at 64±2°C and 3.1±0.4 kilobars. The former is in close agreement with previous determinations by Bridgman; the latter has not been previously reported. A high pressure phase transformation has been measured at 100±5 kilobars. The X-ray diffraction pattern of the phase above 100 kilobars cannot be indexed as cubic suggesting the formation of asymmetric covalent bonding, which is consistent with other lines of evidence.—Authors' abstract

Bastron, Harry. *See* Murata, K. J. 2514

2531 **Bateman, P. C.; Moore, J. G.** Geologic map of the Mount Goddard quadrangle, Fresno and Inyo Counties, California: U.S. Geol. Survey Geol. Quad. Map GQ-429, scale 1:62,500, 1965.

The map sheet includes diagrams and tables of modal analyses of granitic rocks, an inset map showing sample locations, and tables of chemical analyses and norms of Lamarck granodiorite and metavolcanic rocks.—M.C.M.

2318 **Bates, Robert G.** Natural gamma aeroradioactivity map of central Ohio and east-central Indiana: U.S. Geol. Survey Geophys. Inv. Map GP-524, scale 1:250,000, text, 1965.

Because aeroradioactivity data from glaciated regions give little information on the areal distribution of underlying bedrock units, only two correlations of such data were noted in this area—the linear radioactivity highs (500-800 cps) along the Olentangy River and Alum Creek, north of Columbus, where the basal part of the Ohio Shale is exposed along the sides of the stream valleys. There is no obvious geologic explanation for the radioactivity high (500-1,000 cps) south of Dublin, about 10 miles northwest of Columbus. Detailed information on the aeroradioactivity survey of this area is contained in another report (Bates, in preparation).—M.C.M.

Bauleke, Maynard P. *See* Hardy, Ronald G. 2489

2394 **Bauman, Paul T.** Frederick George Phelps (1913-1964): Tulsa Geol. Soc. Digest, v. 32, p. 23, portrait, 1964.

2263 **Beaty, Chester B.** Flint Creek boulder deposit, *in* Geology of the Flint Creek Range, Montana—Billings Geol. Soc., 16th Ann. Field Conf. 1965: Billings, Mont., Billings Geol. Soc., p. 122-126, 1965.

The middle valley of Flint Creek is mantled with a sizeable deposit of granite boulders which previously has been classified as glacial moraine. Beaty concludes that it is not moraine, but a great debris-flow deposit. The boulder field is described and evidence for and against its glacial origin discussed. The boulders must have been transported part way down Boulder Creek by direct glacial action and subsequently moved and redeposited by fluvial action.—E.S.L.

2257 **Bell, L. V.; Moore, H. D., Jr.** Quadrant Formation and Permian strata in the Philipsburg (Maxville) and Garrison districts, *in* Geology of the Flint Creek Range, Montana—Billings Geol. Soc., 16th Ann. Field Conf. 1965: Billings, Mont., Billings Geol. Soc., p. 67-72, tables, 1965.

Permian and Pennsylvanian strata in western Montana are often poorly exposed and it is impossible to obtain complete sections from outcrops. Continuous sections are provided by the phosphate mines, and a table shows correlation of these sections. There is little appreciable change in lithology or thickness of the Quadrant Formation between the Philipsburg and Garrison districts, but there is a marked thinning of Permian formations in the Garrison district. The Shedhorn is completely lacking. There is also considerable contrast in lithology north and south of the Clark Fork River.—E.S.L.

2426 **Bennett, Allan; Hamilton, Donald; Maradudin, Alexei; Miller, Robert; Murphy, Joseph.** Crystals, perfect and imperfect: New York, Walker and Company, 237 p., illus., tables, 1965.

The authors describe how molecules, atoms, and electrons are arranged within various crystals and other solids, and how these lattice formations determine a material's chemical and physical properties. Historical developments are touched on briefly in relation to modern theory and practice. Aspects of atomic bonding, crystal symmetry, the theory and methods of growing crystals, and the way imperfections are created and used are discussed. An appendix gives sources of information for mineral collectors, symbols used in crystallography, and biographical notes on scientists.—E.S.L.

Bennett, Robert R. *See* Bredehoeft, John D. 2679

2365 **Bennison, Alan.** The Cushing field, Creek County, Oklahoma, *in* Symposium on the Arbuckle: Tulsa Geol. Soc. Digest, v. 32, p. 158-159, illus., 1964.

A brief geologic interpretation and description are accompanied by a fold-in structure contour map.—E.S.L.

2585 **Berdam, Jean M.; Zenger, Donald H.** Presence of the ostracode *Drepanellina clarki* in the type Clinton (Middle Silurian) in New York State, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-C, p. C96-C100, illus., 1965.

The ostracode *Drepanellina clarki*, has been found in a thin zone in the uppermost Clinton beds, immediately below the base of the overlying Lockport Formation in the Rome and Utica quadrangles. The horizon of *Drepanellina clarki* appears to be stratigraphically above Gillette's *Paraechmina spinosa* Zone in the Herkimer. The presence of *Drepanellina* in the type Clinton extends the geographic range of the genus and permits a more direct correlation of the Clinton with *Drepanellina clarki* Zone of Ulrich and Bassler elsewhere in the Appalachian region.—*from* Authors' abstract

2169 **Berg, Richard Blake.** Petrology of anorthosite bodies, Bitterroot Range, Ravalli County, Montana [abs.]: Dissert. Abs., v. 25, no. 10, p. 5857-5858, 1965.

Bergquist, Harlan R. *See* Dunlap, John C. 2445

2656 **Berry, D. S.** A theoretical elastic model of the complete region affected by mining a thin seam, *in* Symposium on rock mechanics, 6th, Rolla, Mo., 1964, Proc.: Rolla, Mo., Univ. Missouri, p. 310-329, illus., 1964.

A theoretical elastic model is calculated mathematically to express the deformations (total stress) in an area of ground disturbed by mining. Excavations are considered which are much wider and deeper than their thickness. The problem is defined mathematically by the conditions that over the fully closed area of excavation there is a discontinuity of displacement of magnitude normal to the plane of excavation, the induced stress field over the open parts of the excavation exerts a traction equal in magnitude but opposite in sign to that exerted by the primitive stress, and induced stress is zero at infinity and exerts no traction on the ground surface.—V.S.N.

Bickford, M. E. *See* Wetherill, G. W. 2453

2454 **Bickford, M. E.; Wetherill, G. W.** Compilation of Precambrian data for North America, *in* Geochronology of North America: Natl. Acad. Sci.—Natl. Research Council Nuclear Sci. Ser. Rept. 41 (NAS-NRC Pub. 1276), p. 1-181, tables, 1965.

Absolute age data from Precambrian rocks in North America are discussed briefly according to major patterns which become apparent in plots and tabulations of the data. From youngest to oldest these are: late Precambrian Grenville orogenic belt extending along the eastern continental border from Labrador to Texas; the possible "1,450-m.y. event" in central United States and southern Canada; the Hudsonian orogeny, 1,800 m.y., in the Churchill province of the Canadian Shield; the Kenoran orogeny, 2,500-2,800 m.y., in a continuous area from Quebec through Ontario, Manitoba, Minnesota, North Dakota, Montana, into Wyoming; and possibly older events in the Rainy Lake area, Ontario, and in the Minnesota River valley. Data are tabulated by geographic area under rocks of Grenville age, the Canadian Shield, and Interior and Rocky Mountains.—V.S.N.

2253 **Billings Geological Society.** Geology of the Flint Creek Range, Montana, 16th annual field conference, August, 1965: Billings, Mont., Billings Geol. Soc., 188 p., illus., tables, geol. maps, 1965.

The guidebook includes nine papers on stratigraphy, two on economic geology, two on structure, one general paper, and two geologic maps, a correlation chart, and three road logs.—E.S.L.

2609 **Bingham, James W.; Walters, Kenneth L.** Stratigraphy of the upper part of the Yakima Basalt in Whitman and eastern Franklin Counties, Washington, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-C, p. C87-C90, illus., tables, 1965.

Stratigraphic sections measured about 70 miles and 130 miles east of Sentinel Gap, Wash., on the Columbia Plateau, show a rock sequence similar to the one described by J. H. Mackin in 1961 near Sentinel Gap. The newly measured sequence, in the upper part of the Yakima Basalt, consists of (in descending order) the nonporphyritic Priest Rapids Member, the porphyritic Roza Member, and the sparsely porphyritic Frenchman Springs Member. The key stratigraphic marker is a flow in the Roza Member. The existence of the sequence at widely spaced localities in central and eastern Washington suggests that it is continuous and mappable over large areas of the plateau.—Authors' abstract

2532 **Birtill, J. W.; Whiteway, F. E.** The application of phased arrays to the analysis of seismic body waves: Royal Soc. London Philos. Trans., ser. A, v. 258, no. 1091, p. 421–493, illus., tables, 1965.

The application of phased arrays to body waves is described. An array may be used as a velocity and azimuth filter to improve signal recognition in the presence of microseisms and unwanted signal components. Analysis of array data recorded at Pole Mountain, Wyoming, from the GNOME nuclear explosion enabled a large number of signal components to be identified and permitted deduction of crustal structure between Carlsbad and Pole Mountain. P-waves recorded at ranges of 30°–90°, where the effect of propagation path is small, provide maximum information on source functions. The results from explosions agree with a simple symmetrical impulsive source function; more complex P signals from earthquakes indicate asymmetric source functions.—D.B.V.

2210 **Biscaye, Pierre Eginton.** Mineralogy and sedimentation of the deep-sea sediment fine fraction in the Atlantic Ocean and adjacent seas and oceans [abs.]: Dissert. Abs., v. 25, no. 11, p. 6530–6531, 1965.

Black, R. F. *See* Larochelle, A. 2452

2152 **Blackerby, Bruce Alfred.** The Conejo Volcanics in the Malibu Lake area of the western Santa Monica Mountains, Los Angeles County, California [abs.]: Dissert. Abs., v. 25, no. 12, pt. 1, p. 7199, 1965.

2316 **Blade, Lawrence V.** Geologic map of the Hickory quadrangle, Graves County, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-457, scale 1:24,000, section, text, 1965.

Ball, sagger, and filler clay is produced from clay lenses up to 35 feet thick within the Claiborne(?) Formation; gravel for road metal is found in continental deposits, recent accumulations, and in overburden covering clay deposits; and large supplies of water are available from deep wells in the Claiborne(?) Formation.—M.C.M.

Blanchard, J. E. *See* Keen, M. J. 2463

2376 **Bloesch, Edward.** Arbuckle production and prospects in northeastern Oklahoma, *in* Symposium on the Arbuckle: Tulsa Geol. Soc. Digest, v. 32, p. 43–44, 1964.

The most important Arbuckle production in this area is from the Cushing field, Creek County, and various pools in Osage County, but a few smaller pools are worthy of discussion, and it is these pools that this paper describes.—E.S.L.

2501 **Bluemle, John P.** Geology and ground water resources of Eddy and Foster Counties, North Dakota—Pt. 1, Geology: North Dakota Geol. Survey Bull. 44, pt. 1 (North Dakota Water Conserv. Comm. County Ground Water Study 5, pt. 1), 66 p., illus., tables, geol. map, 1965.

Eddy and Foster Counties are underlain by 3,200–4,300 feet of Paleozoic and Mesozoic rocks; the uppermost Cretaceous Pierre Shale lies beneath the glacial drift which varies from 150–400 feet thick. Glacial landforms include moraines, drumlins, and ice disintegration features. Surficial deposits are chiefly till and outwash, but proglacial and postglacial lake sediments, colluvium, dune sand, and recent alluvium are also present. After active ice had left the area, meltwater from glacial Lake Souris continued to flow through the trenches of the Sheyenne and James Rivers

deepening them and forming extensive terraces. Important economic resources are the soil, ground and surface water, sand and gravel. Conditions for stratigraphic traps exist and further exploratory drilling for oil may prove successful.—M.C.M.

Boegly, W. J. *See* Bradshaw, R. L. 2655

2170 **Boggs, Sam, Jr.** Stratigraphy and petrology of the upper Minturn Formation, east-central Eagle County, Colorado [abs.]: Dissert. Abs., v. 25, no. 10, p. 5858, 1965.

2288 **Bohmer, Harold.** Geology of a rhyolite plug, Pinal County, Arizona: Geol. Soc. America Bull., v. 76, no. 11, p. 1309–1314, geol. map, 1965.

This plug consists of porphyritic rhyolite with partially brecciated interior and glassy rim. Its form is controlled by concentric fractures and septa, but a breccia of triturated schist and rhyolite fragments, possibly formed by explosive, low-viscosity fluidized magma, cross-cuts the enclosing Pinal Schist. The intrusion progressed from an explosive, gaseous beginning to a quiescent final stage.—J.J.H.

Bohor, B. F. *See* Knutson, C. F. 2647

2185 **Borns, Harold William, Jr.; Hagar, David Jon.** Late-glacial stratigraphy of a northern part of the Kennebec River valley, western Maine: Geol. Soc. America Bull., v. 76, no. 11, p. 1233–1250, illus., geol. map, 1965.

Late-glacial stratigraphy includes till and outwash overlain by marine silty clay of the Presumpscot Formation which in turn is gradationally overlain by outwash of the Embden Formation. After erosion of these units by the early Kennebec River, outwash(?) of the North Anson Formation was deposited within the river valley. These and other data suggest that ice persisted in the highlands of New Hampshire and western Maine during the Cary–Port Huron Interstade, perhaps dissipating during the Port Huron–Valders Interstade. The highlands probably later became a center of ice accumulation during the time of the main Valders ice sheet to the north.—A.G.

2196 **Bowie, S. H. V.** Minutes of meeting of I.M.A. Commission on Ore Microscopy held in Paris, May 1st, 1965: Econ. Geology, v. 60, no. 8, p. 1759–1761, 1965.

2325 **Bownocker, J. A.** Geologic map of Ohio: Columbus, Ohio Div. Geol. Survey, scale 1:500,000, reprinted 1965; originally published 1947.

2153 **Bowser, Carl James.** Geochemistry and petrology of the sodium borates in the non-marine evaporite environment [abs.]: Dissert. Abs., v. 25, no. 12, pt. 1, p. 7199–7200, 1965.

2194 **Boyle, R. W.** A review and discussion of present geophysical methods applied in mining exploration [discussion of paper by A. A. Brant, 1965]: Econ. Geology, v. 60, no. 8, p. 1739–1740, 1965.

In this discussion of the paper by Brant (ibid., v. 60, no. 4, p. 819–821, 1965), Boyle comments that geochemical anomalies are detectable in areas of permafrost and glacial drift.—W.S.W.

Brabb, Earl E. *See* Churkin, Michael, Jr. 2685

Bradbury, John P. *See* Kirkland, Douglas W. 2507

2380 **Bradfield, H. H.** The Ellenburger Group of north central Texas, *in* Symposium on the Arbuckle: Tulsa Geol. Soc. Digest, v. 32, p. 112–118, illus., 1964.

This paper presents some of the general aspects of Ellenburger deposition, present distribution, and regional structural features. Structure and isopach maps are included, and the effect of the Concho, Muenster and Red River arches on deposition is examined. Occurrence of oil and gas is discussed also.—E.S.L.

2655 **Bradshaw, R. L.; Boegly, W. J.; Empson, F. M.** Correlation of convergence measurements in salt mines with laboratory creep-test data, *in* Symposium on rock mechanics, 6th, Rolla, Mo., 1964, Proc.: Rolla, Mo., Univ. Missouri, p. 501–514, illus., tables, 1964.

Laboratory pillar model tests, of 1,000 hours or less duration, run at several different values of average pillar stress, appear to be sufficient to allow the development of an empirical equation which can be used to predict vertical closure rates in salt mine openings up to 70 years old.—*from* Authors' conclusions

Brannock, W. W. *See* Murata, K. J. 2514

2235 **Branson, Carl C.** New specimens of *Homotelus* from the Bromide Formation: Oklahoma Geology Notes, v. 25, no. 11, p. 294–296, illus., 1965.

The trilobite *Homotelus bromidensis* was originally described by Esker (1964) on the basis of three specimens (none showing the hypostome), from Spring Creek in the type section of the Poolesville Member of the Bromide Formation (Ordovician), Murray County, and from Rock Crossing in Criner Hills, Carter County. Specimens from these localities identified by Laudon (1939) and Loeblich (1940) as *Isotelus gigas* were referred to *H. bromidensis* by Esker (1964). Recently a prepared slab was obtained from Criner Hills containing 28 specimens of *H. bromidensis*, seven of which show the hypostome; it is of characteristic isotelid type.—V.M.J.

2679 **Bredehoeft, John D.; Cooper, Hilton H., Jr.; Papadopulos, Istavros S.; Bennett, Robert R.** Seismic fluctuations in an open artesian water well, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-C, p. C51–C57, illus., 1965.

The degree to which the water level in an open well responds to a seismic wave is determined by the dimensions of the well, the transmissibility, storage coefficient and porosity of the aquifer, and the period and amplitude of the wave. The amplitude of the vertical land-surface motion associated with Rayleigh waves may be computed, provided sufficient data regarding the above parameters are available. Conversely, if the amplitude of vertical land-surface motion is known, the water-level fluctuations can be computed. Analysis of fluctuations caused by the "Good Friday" earthquake of March 27, 1964, in a well near Perry, Taylor County, in northern Florida, illustrates the theory. . . .—Authors' abstract

Brentnall, David. *See* Attewell, Peter. 2688

2515 **Brew, David A.; Muffler, L. J. Patrick.** Upper Triassic undevitrified volcanic glass from Hound Island, Keku Strait, southeastern Alaska, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-C, p. C38–C43, illus., 1965.

Angular clasts of undevitrified basaltic glass occur in bedded calcareous vitric aquagene tuff that is part of a fossiliferous Upper Triassic sequence of pillow breccia, pillow lava, massive lava, tuff, and limestone. The glass fragments are of very fine sand to granule size and are tightly cemented by sparry calcite. . . . Other similar fragments in the tuff are patchily devitrified to light-green crystalline material, and still other fragments are thoroughly devitrified and slightly rounded. A K–Ar age of 126 m.y. was obtained on carefully selected fragments of the fresh glass. The discrepancy between this date and the 180–200 m.y. age predicted from the paleontologic evidence is probably due to loss of radiogenic argon.—Authors' abstract

Brewer, John. *See* Waller, R. K. 2364

2552 **Brice, James C.** Relief forms of mountain belts—The effects of rock structure and fundamental form: Lab. Studies Geology 209, 17 p., illus., 1964.

Airphotos and diagrams illustrate this laboratory manual for use in the study of North American geomorphology.—E.S.L.

2553 **Brice, James C.** Relief forms of mountain belts—The effects of climate: Lab. Studies Geology 210, 17 p., illus., 1964.

Airphotos and diagrams illustrate this laboratory manual for use in the study of North American geomorphology.—E.S.L.

2554 **Brice, James C.** Relief forms of the continental plate: Lab. Studies Geology 211, 16 p., illus., 1964.

Airphotos and diagrams illustrate this laboratory manual for use in the study of North American geomorphology.—E.S.L.

2555 **Brice, James C.** Ground water: Lab. Studies Geology 212, 10 p., illus., 1964.

This laboratory manual begins with instructions for making and using an experimental analogue of the ground-water table. Other exercises for study of porosity and permeability are given.—E.S.L.

2241 **British Columbia Department of Mines.** Lode metals: British Columbia Dept. Mines and Petroleum Resources Ann. Rept. 1964, p. 1–170, illus., tables, geol. maps, 1965.

This is a review of the geology and occurrence of lode metals in British Columbia.—E.S.L.

2242 **British Columbia Department of Mines.** Structural materials and industrial minerals: British Columbia Dept. Mines and Petroleum Resources Ann. Rept. 1964, p. 179–208, illus., tables, geol. maps, 1965.

This is a review of the geology and occurrence of structural materials and industrial minerals in British Columbia.—E.S.L.

Brock, M. R. *See* Barker, Fred. 2423

2483 **Broeker, Margaret E.; Winslow, John D.** Ground-water levels in observation wells in Kansas, 1964: Kansas Geol. Survey Bull. 177, 93 p., illus., tables, 1965.

Measurements of water levels in 866 wells in 75 counties in Kansas during 1964 are given in this report, the ninth in a series of annual water-level reports published by the State Geological Survey of Kansas. Ground-water levels, in general, had a net decline for the year as the result of below-normal precipitation over most of the State. Extensive use of ground water for irrigation accelerated the decline of ground-water levels in parts of western Kansas.—Authors' abstract

2633 **Brophy, G. P.; Sheridan, M. F.** Sulfate studies—[Pt.] 4, The jarosite–natrojarosite–hydronium jarosite solid solution series: Am. Mineralogist, v. 50, no. 10, p. 1595–1607, illus., tables, 1965.

Solid solutions exist in jarosite by K–Na–H_3O substitution. The presence of hydronium can best be detected by X-ray plus thermal data. A pronounced weight loss from 240°C to 280°C corresponds to the amount of H_2O that can be assigned to hydronium in each jarosite. The *a* cell dimension of jarosite is nearly constant, but the *c* dimension is compositionally sensitive: 17.192 A for K-jarosite, 16.980A for H_3O-jarosite, 16.620A for Na-jarosite. The regression is non-linear. The amount of H_3O in synthetic jarosite decreases with increasing T and P.—E.Z.

Brosge, W. P. *See* Reiser, H. N. 2605

Broughton, M. N. *See* McHugh, James W. 2402

2278 **Brown, Charles Quentin, Sr.** Clay mineralogy of sediments and source materials in the York River tributary basin [abs.]: Dissert. Abs., v. 25, no. 10, p. 5976, 1965.

2154 **Bryers, Wesley E.** The Mesa Central of Mexico as a mineralogenic province [abs.]: Dissert. Abs., v. 25, no. 12, pt. 1, p. 7200–7201, 1965.

Bucknam, Robert C. *See* Zartman, Robert. 2672

2492 **Bullis, Harvey R., Jr.; Roe, Richard B.** Colmer Knoll—A new feature in the Yucatan Channel approaches [with Spanish abs.]: Bull. Marine Sci., v. 15, no. 3, p. 612–615, illus., 1965.

In June 1964, an uncharted, flat-topped knoll, rising to a depth of 150 fathoms, was discovered 30 miles east of Cozumel Island, Mexico, by the R/V *Oregon*. Using a radar buoy for position reference, a series of depth recorder transects was conducted over the structure. A contour chart of the knoll is presented. The name "Colmer Knoll" is proposed for this structure.—Authors' abstract

Bunch, Ted E. *See* Reid, Arch M. 2551

2485 **Bunting, Brian T.** The geography of soil: Chicago, Aldine Publishing Co., 213 p., illus., tables, 1965.

Results of modern national and international soil studies are presented within the traditional framework of the "Great Soil Groups" on a regional, rather than zonal, basis. The 17 chapters include discussion of inorganic, organic, climatic, geomorphic, and time factors in soil formation; types of soils; and soils characteristic of major climatic zones. A reference list is included with each chapter, and a selected general bibliography is appended.—V.S.N.

2417 **Burgess, W. J.** Dolomitization [abs.]: Tulsa Geol. Soc. Digest, v. 32, p. 172–173, 1964.

2377 **Burgess, William J.** Stratigraphic dolomitization in Arbuckle rocks in Oklahoma, *in* Symposium on the Arbuckle: Tulsa Geol. Soc. Digest, v. 32, p. 45–48, illus., 1964.

Penecontemporaneous dolomitization in Arbuckle rocks occurred apparently a short time after deposition before very much compaction had taken place. In many zones two types of dolomitic mottling can be distinguished—depositionally controlled and organically or biologically controlled. The process and its effect on the rock is described.—E.S.L.

2625 **Byrne, John V.** Morphometry of Crater Lake, Oregon: Limnology and Oceanography, v. 10, no. 3, p. 462–465, illus., table, 1965.

Two bathymetric charts, one with depths in fathoms and one in meters, were compiled from more than 4,000 soundings from the 1959 U.S. Coast and Geodetic survey. Geomorphic features of interest are a lobe extending eastward from Wizard Island, probably a lava flow; a conical hill at the inner edge, a dome partially buried by the flow; and the cone rising to within 148 m of the surface in the north-central part of the lake. The lake is deepest, 589 m, southeast of this cone, where the bottom is flat.—E.S.L.

2200 **Cabri, Louis J.** Phase relations in the Au–Ag–Te systems and their mineralogical significance: Econ. Geology, v. 60, no. 8, p. 1569–1606, illus., tables, 1965.

By X-ray and microscopic techniques, equilibrium relations were determined in the presence of vapor at 290°, 335°, and 355°C, and changes in assemblages studied from about 50° to 800°C. A new ternary eutectic at about 304°C has the approximate composition 50 percent Au, 15 percent Ag, 35 percent Te (wt. percent). Krennerite, a single mineral entity with the approximate formula Au_4AgTe_{10}, is stable up to its incongruent melting at about 382°C. Sylvanite melts incongruently at about 354°C. Hessite and petzite each have three polymorphs.—W.S.W.

2438 **Callahan, J. T.; Newcomb, L. E.; Geurin, J. W.** Water in Georgia: U.S. Geol. Survey Water-Supply Paper 1762, 88 p., illus., 1965.

The occurrence and use of water in the State of Georgia are summarized. Water problems such as droughts, floods, water quality, and declining water levels are

discussed, and possible future demands for water in Georgia are examined for the non-technically trained reader.—W.L.G.

2418 **Calvert, Warren L.** Ohio's petroleum development and geological occurrence [abs.]: Tulsa Geol. Soc. Digest, v. 32, p. 174–175, 1964.

Cameron, Eugene N. *See* vanRensburg, Willem C. J. 2205

2678 **Cameron, Eugene N.; Carpenter, Robert H.** Photometric measurement of rotation properties: Am. Mineralogist, v. 50, no. 10, p. 1608–1617, illus., 1965.

Photometric measurement of rotation properties is described and illustrated by measurements for breithauptite. Photometric measurements of A_r can have 3 to 5 times the precision of visual measurements, and photometric measurements of 2θ can be 5 to 10 times as precise as visual measurements. Photometric measurements of maximum precision are more time-consuming than visual methods and require special adaptation of the analyzer, but they have possible applications in measurement of standard values of rotation properties and in studies of crystal orientation. The photometric method may also be used with ordinary microscope equipment as a substitute for the visual method. Measurements then require no more time than visual methods and are equally precise.—Authors' abstract

2310 **Canada Dept. Mines Tech. Surveys.** (Mineral Resources Division). Canadian minerals yearbook 1963: Canada Dept. Mines and Tech. Surveys Mineral Resources Div. Mineral Rept. 10, 640 p., illus., tables, 1965.

The summary of the Canadian mineral industry is in two parts: the first consisting of descriptive analyses of the year's developments and the other of statistical analyses set out in 59 tables. An introductory section in the first part provides a brief survey of the industry's progress and problems, followed by a summary of highlights for each of the principal mineral commodities and by an appraisal of developments in mining technology. An analysis is made of trends in 11 sectors of the industry by referring to the statistical tables in the second part. Information is included throughout to relate progress in the mineral industry to the Canadian economy as a whole.—M.C.M.

2146 **Canada Geological Survey.** Aeromagnetic map, Sheet 65 C/3, District of Keewatin, Northwest Territories: Canada Geol. Survey Geophysics Paper 3134, scale 1:63,360, 1965.

2693 **Canada Geological Survey.** Aeromagnetic map, Hay Point, Saskatchewan: Canada Geol. Survey Geophys. Paper 2829, scale 1:63,360, 1965.

2694 **Canada Geological Survey.** Aeromagnetic map, McCoy Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2830, scale 1:63,360, 1965.

2695 **Canada Geological Survey.** Aeromagnetic map, Singleton Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2831, scale 1:63,360, 1965.

2696 **Canada Geological Survey.** Aeromagnetic map, Little Flatstone Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2832, scale 1:63,360, 1965.

2697 **Canada Geological Survey.** Aeromagnetic map, Studer Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2833, scale 1:63,360, 1965.

2698 **Canada Geological Survey.** Aeromagnetic map, Cup Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2834, scale 1:63,360, 1965.

2699 **Canada Geological Survey.** Aeromagnetic map, George Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2835, scale 1:63,360, 1965.

2700 **Canada Geological Survey.** Aeromagnetic map, Hewetson Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2836, scale 1:63,360, 1965.

2701 **Canada Geological Survey.** Aeromagnetic map, Nagle Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2837, scale 1:63,360, 1965.

2702 **Canada Geological Survey.** Aeromagnetic map, Paull Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2838, scale 1:63,360, 1965.

2703 **Canada Geological Survey.** Aeromagnetic map, Maribelli Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2839, scale 1:63,360, 1965.

2704 **Canada Geological Survey.** Aeromagnetic map, Waddy Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2840, scale 1:63,360, 1965.

2705 **Canada Geological Survey.** Aeromagnetic map, Royal Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2841, scale 1:63,360, 1965.

2706 **Canada Geological Survey.** Aeromagnetic map, Harriott Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2842, scale 1:63,360, 1965.

2707 **Canada Geological Survey.** Aeromagnetic map, Kamatsi Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2843, scale 1:63,360, 1965.

2708 **Canada Geological Survey.** Aeromagnetic map, Heise Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2780, scale 1:63,360, 1965.

2709 **Canada Geological Survey.** Aeromagnetic map, Tocker Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2781, scale 1:63,360, 1965.

2710 **Canada Geological Survey.** Aeromagnetic map, Parker Bay, Saskatchewan: Canada Geol. Survey Geophys. Paper 2782, scale 1:63,360, 1965.

2711 **Canada Geological Survey.** Aeromagnetic map, McArther Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2783, scale 1:63,360, 1965.

2712 **Canada Geological Survey.** Aeromagnetic map, Black Birch Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2784, scale 1:63,360, 1965.

2713 **Canada Geological Survey.** Aeromagnetic map, Gwillim Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2785, scale 1:63,360, 1965.

2714 **Canada Geological Survey.** Aeromagnetic map, Desnomie Lakes, Saskatchewan: Canada Geol. Survey Geophys. Paper 2786, scale 1:63,360, 1965.

2715 **Canada Geological Survey.** Aeromagnetic map, Haultain Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2787, scale 1:63,360, 1965.

2716 **Canada Geological Survey.** Aeromagnetic map, Costigan Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2788, scale 1:63,360, 1965.

2717 **Canada Geological Survey.** Aeromagnetic map, Burbridge Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2789, scale 1:63,360, 1965.

2718 **Canada Geological Survey.** Aeromagnetic map, Pendleton Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2790, scale 1:63,360, 1965.

2719 **Canada Geological Survey.** Aeromagnetic map, Jewell Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2791, scale 1:63,360, 1965.

2720 **Canada Geological Survey.** Aeromagnetic map, Wathaman Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2792, scale 1:63,360, 1965.

2721 **Canada Geological Survey.** Aeromagnetic map, Oliver Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2793, scale 1:63,360, 1965.

2722 **Canada Geological Survey.** Aeromagnetic map, Perry Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2794, scale 1:63,360, 1965.

2723 **Canada Geological Survey.** Aeromagnetic map, Amiskit Island, Saskatchewan–Manitoba: Canada Geol. Survey Geophys. Paper 2795, scale 1:63,360, 1965.

2724 **Canada Geological Survey.** Aeromagnetic map, Wallis Bay, Saskatchewan: Canada Geol. Survey Geophys. Paper 2796, scale 1:63,360, 1965.

2725 **Canada Geological Survey.** Aeromagnetic map, McLean River, Saskatchewan: Canada Geol. Survey Geophys. Paper 2797, scale 1:63,360, 1965.

2726 **Canada Geological Survey.** Aeromagnetic map, Turnor Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2798, scale 1:63,360, 1965.

2727 **Canada Geological Survey.** Aeromagnetic map, Josephson Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2799, scale 1:63,360, 1965.

2728 **Canada Geological Survey.** Aeromagnetic map, Heddery Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2800, scale 1:63,360, 1965.

2729 **Canada Geological Survey.** Aeromagnetic map, Grand Rapids, Saskatchewan: Canada Geol. Survey Geophys. Paper 2801, scale 1:63,360, 1965.

2730 **Canada Geological Survey.** Aeromagnetic map, Boffa Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2802, scale 1:63,360, 1965.

2731 **Canada Geological Survey.** Aeromagnetic map, Smalley Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2803, scale 1:63,360, 1965.

2732 **Canada Geological Survey.** Aeromagnetic map, Daly Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2804, scale 1:63,360, 1965.

2733 **Canada Geological Survey.** Aeromagnetic map, Middle Foster Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2805, scale 1:63,360, 1965.

2734 **Canada Geological Survey.** Aeromagnetic map, Dobbin Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2806, scale 1:63,360, 1965.

2735 **Canada Geological Survey.** Aeromagnetic map, Deception Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2807, scale 1:63,360, 1965.

2736 **Canada Geological Survey.** Aeromagnetic map, Macoun Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2808, scale 1:63,360, 1965.

2737 **Canada Geological Survey.** Aeromagnetic map, Ghana Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2809, scale 1:63,360, 1965.

2738 **Canada Geological Survey.** Aeromagnetic map, Milton Island, Saskatchewan: Canada Geol. Survey Geophys. Paper 2810, scale 1:63,360, 1965.

2739 **Canada Geological Survey.** Aeromagnetic map, Bleasdell Lake, Saskatchewan–Manitoba: Canada Geol. Survey Geophys. Paper 2811, scale 1:63,360, 1965.

2740 **Canada Geological Survey.** Aeromagnetic map, Garson Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2812, scale 1:63,360, 1965.

2741 **Canada Geological Survey.** Aeromagnetic map, McLean Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2813, scale 1:63,360, 1965.

2742 **Canada Geological Survey.** Aeromagnetic map, McAneeley Bay, Saskatchewan: Canada Geol. Survey Geophys. Paper 2814, scale 1:63,360, 1965.

2743 **Canada Geological Survey.** Aeromagnetic map, Frobisher Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2815, scale 1:63,360, 1965.

2744 **Canada Geological Survey.** Aeromagnetic map, Gillies Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2816, scale 1:63,360, 1965.

2745 **Canada Geological Survey.** Aeromagnetic map, Porter Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2817, scale 1:63,360, 1965.

2746 **Canada Geological Survey.** Aeromagnetic map, Complex Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2818, scale 1:63,360, 1965.

2747 **Canada Geological Survey.** Aeromagnetic map, Norbert Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2819, scale 1:63,360, 1965.

2748 **Canada Geological Survey.** Aeromagnetic map, Pylypow Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2820, scale 1:63,360, 1965.

2749 **Canada Geological Survey.** Aeromagnetic map, Barnett Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2821, scale 1:63,360, 1965.

2750 **Canada Geological Survey.** Aeromagnetic map, Rottenstone Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2822, scale 1:63,360, 1965.

2751 **Canada Geological Survey.** Aeromagnetic map, Hickson Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2823, scale 1:63,360, 1965.

2752 **Canada Geological Survey.** Aeromagnetic map, May Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2824, scale 1:63,360, 1965.

2753 **Canada Geological Survey.** Aeromagnetic map, Southend, Saskatchewan: Canada Geol. Survey Geophys. Paper 2825, scale 1:63,360, 1965.

2754 **Canada Geological Survey.** Aeromagnetic map, Finlayson Lake, Saskatchewan: Canada Geol. Survey Geophys. Paper 2826, scale 1:63,360, 1965.

2755 **Canada Geological Survey.** Aeromagnetic map, Wapus Lake, Saskatchewan–Manitoba: Canada Geol. Survey Geophys. Paper 2827, scale 1:63,360, 1965.

2155 **Card, Kenneth Darius Huycke.** Geology of the Agnew Lake area, Ontario—A study in Precambrian stratigraphy, structure and metamorphism [abs.]: Dissert. Abs., v. 25, no. 12, pt. 1, p. 7201, 1965.

2623 **Carlston, Charles W.** The relation of free meander geometry to stream discharge and its geomorphic implications: Am. Jour. Sci., v. 263, no. 10, p. 864–885, illus., table, 1965.

The wave length of free meanders is related to stream discharge. The dominant discharge controlling the wave length is a range of flows, possibly of falling stages, between the mean discharge for the month of maximum discharge and the mean annual discharge. Length of slope may also affect wave length.—D.L.D.

2488 **Carpenter, G. L.** Oil development and production in Indiana during 1963: Indiana Geol. Survey Mineral Economics Ser. 10, 19 p., illus., tables, 1964.

During 1963 fewer wells were drilled for oil and gas in Indiana than during any year since 1957, and although total oil production decreased, secondary oil production increased. The greatest number and most significant exploratory successes were in Posey County. Anticipated production is in Mississippian and Pennsylvanian rocks in southwestern Indiana.—M.C.M.

2512 **Carpenter, G. L.** Oil development and production in Indiana during 1964: Indiana Geol. Survey Mineral Economics Ser. 11, 20 p., illus., tables, 1965.

Oil production and overall drilling declined in Indiana in 1964 as they did in 1963, most of the decline being in primary oil production. Of the 297 exploratory holes, 44 were successful—38 were completed in Mississippian rocks and 2 each in Pennsylvanian, Devonian, and Ordovician rocks. Significant exploration programs to test rocks of early Ordovician and Cambrian age for oil or gas have been initiated in eastern Indiana because of the dolomite discoveries in rocks of the same age in central Ohio. In much of this area of interest, the top of the Cambrian and

Ordovician Knox Dolomite can be reached at depths ranging from 800 to 2,000 feet.—M.C.M.

2156 **Carpenter, John Richard.** Influence of structural deformation on some aspects of metamorphic differentiation [abs.]: Dissert. Abs., v. 25, no. 12, pt. 1, p. 7201–7202, 1965.

Carpenter, Robert H. *See* Cameron, Eugene N. 2678

Carr, W. J. *See* Poole, F. G. 2386

2607 **Castle, R. O.** A proposed revision of the subalkaline intrusive series of northeastern Massachusets, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525–C, p. C74–C80, illus., table, 1965.

The subalkaline intrusive series of northeastern Massachusets as given by C. H. Clapp in 1921 is revised to include the following units: (1) the Sharpners Pond Tonalite, (2) the Newburyport Quartz Diorite as mapped south and west of Boxford, (3) a "younger subalkaline intrusive series" defined by Toulmin in 1964, and (4) the Andover Granite. Inclusion of the Andover Granite with the "alkalic" intrusive series is rejected owing chiefly to its continuity with the demonstrably pre-"alkalic" Sharpners Pond Tonalite.—Author's abstract

2608 **Castle, R. O.** Gneissic rocks in the South Groveland quadrangle, Essex County, Massachusetts, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525–C, p. C81–C86, illus., tables, 1965.

Detailed mapping in the South Groveland quadrangle has made possible the division of the gneissic rocks in this area into the Fish Brook Gneiss and the Boxford Formation. The Fish Brook Gneiss is a relatively uniform fine- to medium-grained, quartz-plagioclase gneiss, possibly representing an isolated intrusion or "dome" gneiss. The Boxford Formation consists of a lower member composed chiefly of mica schists and quartz-feldspathic gneisses and an upper member of predominantly amphibolitic rocks. It may be correlative with the Rye Formation of southeastern New Hampshire and possibly with the Marlboro Formation of eastern New Hampshire.—W.L.G.

2189 **Chantell, Charles J.** A lower Miocene *Acris* (Amphibia: Hylidae) from Colorado: Jour. Paleontology, v. 39, no. 3, p. 507–508, illus., 1965.

A hylid ilium from the Martin Canyon local fauna, Pawnee Creek Formation, Logan County, comes from a lower Miocene representative of population lines leading to modern *Acris crepitans* or *A. gryllus*.—F.C.W.

2505 **Charron, J. E.** Groundwater resources of Winnipeg area, Manitoba (townships 6 to 12, ranges 1 to 5, east of principal meridian): Canada Geol. Survey Paper 64–23, 30 p., illus., tables, geol. map, 1965.

This area, covering 1,080 sq mi in the Red River basin, contains two ground-water basins. The geochemistry of 37 ground-water analyses has established the direction of movement within these basins to be westward in the larger and southward in the other. In general, the static ground-water level of the area is lowering each year and the salt-water—fresh-water boundary is receding eastward and northward. Hundreds of small ridges that occur as swells in the lacustrine plain are probably ice-crack features. Analyses are shown in tables and graphs, and a fence diagram and maps showing the surficial geology and potable ground-water availability accompany the paper.—E.S.L.

Chase, Thomas E. *See* Engel, Celeste G. 2597

2674 **Chayes, Felix.** Classification in a ternary diagram by means of discriminant functions: Am. Mineralogist, v. 50, no. 10, p. 1618–1633, illus., tables, 1965.

For ternary closed data, discriminant functions based on polynomials of the form $\Sigma(Xi+Xj)^p$, summed from $p=1$ to $p=q$, are analytically equivalent and geometrically

identical for $1 \leq i+j \leq 3$. For any assigned value of q, only a single function need be calculated and it makes no difference which pair of variables is used. The relation can be generalized for an M-variable closed array in the form $\Sigma(X_1+X_2+\ldots+X_{m-1})^p$ (p summed from 1 to q). No other polynomial of the same order in these variables will yield a more efficient discriminant.—E.Z.

2211 **Chen, Chih Shan.** The regional lithostratigraphic analysis of Paleocene and Eocene rocks of Florida [abs.]: Dissert. Abs., v. 25, no. 11, p. 6531, 1965.

2212 **Chen, Ping-fan.** Geology and mineral resources of the Goose Creek area near Roanoke, Virginia [abs.]: Dissert. Abs., v. 25, no. 11, p. 6532, 1965.

2234 **Chenoweth, Philip A.** Caney River arch, a pre-Seminole uplift in northeastern Oklahoma: Oklahoma Geology Notes, v. 25, no. 11, p. 279–286, illus., 1965.

Outcrop, pre-Missourian subcrop, and Missourian limestone thickness maps of northeastern Oklahoma are interpreted to outline the development of a late Desmoinesian uplift, here designated the Caney River arch, and its structural control of Missourian carbonate deposition. Reeflike limestone banks of the Hogshooter and Dewey Formations, in particular, appear to have been restricted to the flanks of the uplift, which during the time of deposition was probably a slightly elevated submarine topographic feature. Later Pennsylvanian history of the region is characterized by repeated advances and withdrawals of the sea; during some of the withdrawals, the Caney River feature was gently re-arched.—V.M.J.

2584 **Cherry, Rodney N.** A portable sampler for collecting water samples from specific zones in uncased or screened wells, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-C, p. C214–C216, illus., table, 1965.

This paper describes a water sampler for use in uncased or screened wells which tap more than one water-bearing zone. It consists of two inflatable packers, and of a submersible pump which removes water from the section of the well isolated by the packers. Auxiliary instruments can be used to measure temperature, specific conductance, or other characteristics of the water in the isolated interval during pumping. The sampler is easily handled and is readily moved from one position to another and reset without removing it from the well.—Author's abstract

2689 **Cherry, Rodney N.** Multiple hydrologic-parameter recording on a digital recorder, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-D, p. D222–D224, illus., 1965.

A multiple-parameter modification of a digital recorder measures and records hydrologic parameters that can be sensed as electrical resistance. The digital recorder collects data on tape for processing by electronic computer and is therefore especially useful where large volumes of data are to be collected and analyzed. The modified apparatus is portable and battery powered, and it can be left untended for 3 to 4 weeks. The multiple-parameter recorder described measures and records 4 parameters (2 values of water temperature and 2 values of specific electrical conductance) on punched tape, and also records one of these parameters in visible form on a paper chart.—Author's abstract

Christiansen, Carl R. *See* Spokes, Ernest M. 2641

2606 **Churkin, Michael, Jr.** First occurrence of graptolites in the Klamath Mountains, California, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-C, p. C72–C73, 1965.

Silurian graptolites have been found recently in the Klamath Mountains in shale and siltstone of the Gazelle Formation below its fossiliferous Payton Ranch Limestone Member (Middle or Upper Silurian). They confirm that part of the Gazelle Formation is at least as old as Middle Silurian. The graptolites provide a potentially useful tool in establishing the stratigraphic succession in this structurally complex region.—Author's abstract

2685 **Churkin, Michael, Jr.; Brabb, Earl E.** Occurrences and stratigraphic significance of *Oldhamia*, a Cambrian trace fossil, in east-central Alaska, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-D, p. D120-D124, illus., 1965.

Abundant specimens of *Oldhamia*, a fan shaped trace fossil of probable Cambrian age, were found in the Charley River quadrangle near the Alaska-Canada boundary. . . . Assignment of this Alaskan *Oldhamia* to the Lower Cambrian is consistent with the Cambrian or possibly latest Precambrian age of *Oldhamia* in Europe and eastern North America. Occurrences of *Oldhamia* in the Mount Schwatka area and in the Crazy Mountains, about 180 and 100 miles, respectively, west of the Charley River quadrangle, suggest that rocks of Cambrian age, much older than previously reported, are probably present in the central interior of Alaska.—Authors' abstract

2378 **Clark, Joe Marsh.** The Arbuckle of northwest Arkansas, *in* Symposium on the Arbuckle: Tulsa Geol. Soc. Digest, v. 32, p. 76-90, illus., tables, 1964.

Cambrian-Ordovician and Arbuckle are used interchangeably in this paper. The rocks are mainly in the subsurface and identification is dependent on correlation with the surface section elsewhere. The formations are described and equivalents listed where known. Lithofacies, isopach, and structure contour maps are included. Total thickness does not seem to vary much. Oil and gas possibilities are discussed briefly.—E.S.L.

Clark, Lorin D. *See* Zapp, Alfred D. 2631

2691 **Clark, William E.** Relation of ground-water inflow and of bank and channel storage to streamflow pickup in the Santa Fe River, Florida, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-D, p. D211-D213, illus., 1965.

The pickup in flow of the Santa Fe River in the 8-mile reach between gaging stations near High Springs and near Fort White, in north-central Florida, averages about 800 cfs and is provided entirely or almost entirely by ground-water runoff. The magnitude of streamflow pickup in this reach changes slowly, or is almost uniform, except during times of flood. At those times part of the floodwater derived from surface runoff in the region upstream goes into channel and bank storage while passing through this reach. During succeeding periods of resumed base flow, this water drains back into the stream.—Author's abstract

Clemens, William A. *See* Jeletzky, J. A. 2430

2662 **Coats, R. R.; Marvin, R. F.; Stern, T. W.** Reconnaissance of mineral ages of plutons in Elko County, Nevada, and vicinity, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-D, p. D11-D15, illus., table, 1965.

The small and scatered plutons of silicic rock in Elko County, northeastern Nevada, and vicinity have long been known to be post-Paleozoic and pre-late-Tertiary. Nine pairs of K-Ar and Pb-α dates from 9 plutons give generally reasonable agreement and fall into 3 age groups: Middle Jurassic, Late Cretaceous, and Oligocene. Cretaceous plutons generally lie north of Jurassic ones, an arrangement analogous to that in the Sierra Nevada; two Tertiary granodiorite plutons were apparently intruded along inferred major transverse faults.—Authors' abstract

2392 **Cohee, George V.; West, Walter S.** Changes in stratigraphic nomenclature by the U.S. Geological Survey, 1964: U.S. Geol. Survey Bull. 1224-A, p. A1-A77, illus., table, 1965.

In the following listings, the changes in stratigraphic nomenclature are grouped together in the categories of (1) new names adopted, (2) previously used names adopted, (3) names revised, (4) changes in age designation, (5) names reinstated, and (6) names abandoned. The stratigraphic names involved in change are listed alphabetically under each category. The age of the unit, the area in which the name is employed, the title of the report, and the publication in which the change is described are given.—Authors' introduction

Cohen, Alvin J. *See* Reid, Arch M. 2551

Coker, Alfred E. *See* Finlayson, C. Pratt. 2347

Colbert, J. L. *See* Young, L. L. 2439

2457 **Cole, W. Storrs.** Memorial to Oskar Dietrich von Engeln (1880–1965): Geol. Soc. America Bull., v. 76, no. 10, p. P153–P156, portrait, 1965.

2680 **Coleman, Robert G.** Composition of jadeitic pyroxene from the California metagraywackes, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525–C, p. C25–C34, illus., tables, 1965.

The average molecular composition, optics, unit-cell constants, and density are given for purified jadeitic pyroxene from quartz-jadeitic pyroxene-lawsonite-muscovite-glaucophane-bearing metagraywackes from the Franciscan Formation in California. The presence of significant amounts of pyroxene components other than jadeite suggests conversion of albite to pure jadeite+quartz at lower pressures and temperatures than those found experimentally. Petrologic and chemical evidence indicates that conversion of graywacke to the quartz-jadeitic pyroxene-lawsonite-muscovite-glaucophane assemblage takes place without introduction of alkalies.—W.L.G.

2419 **Colombo, Umberto.** The evolution of petroleum [abs.]: Tulsa Geol. Soc. Digest, v. 32, p. 175, 1964.

Conant, Georgianna D. *See* King, Ruth Reece. 2444

2396 **Conhaim, Howard J.** Allen Walter Tillotson (1905–1964): Tulsa Geol. Soc. Digest, v. 32, p. 25, portrait, 1964.

Conklin, Nancy M. *See* Staatz, Mortimer H. 2576

2238 **Conley, James F.; Drummond, Kenneth M.** Ultramylonite zones in the western Carolinas: Southeastern Geology, v. 6, no. 4, p. 201–211, illus., table, 1965.

Northeast trending, narrow, dike-like zones of flinty ultramylonite occur in the Piedmont and Blue Ridge regions of Burke, Rutherford, Polk, and Henderson Counties in North Carolina, and Spartanburg and Greenville Counties in South Carolina. They vary greatly in length and width, but are relatively uniform in appearance, composition, and texture, even though they are enclosed by a diverse assemblage of rocks. The ultramylonite is composed of indurated, cryptoclastic rock and mineral particles that consist of sheared quartz grains, feldspar, sericite, kaolinite, and a dark material of glassy aspect. The zones probably developed along major lateral faults during Triassic time. Subsequent movement, probably during Tertiary, caused brecciation.—E.S.L.

2213 **Connally, George Gordon.** The Almond Moraine of the western Finger Lakes region, New York [abs.]: Dissert. Abs., v. 25, no. 11, p. 6532–6533, 1965.

2487 **Conover, C. S.; MacKichan, K. A.; Pride, R. W.** The water mapping, monitoring and research program in Florida: Florida Geol. Survey Spec. Pub. 13, 41 p., illus., tables, 1965.

The objectives of the cooperative water resources program in Florida are: to determine and evaluate quantity and quality of water on the surface and underground; to determine effects of present or potential development and use by man; and to improve understanding of physical laws, processes, and mechanics of various phases of the hydrologic cycle. The present program includes collection and publication of hydrologic records, descriptive investigations to define occurrence and quality of water in a particular area, interpretive investigations to consider dynamics and interrelations of the hydrologic system, and investigations to increase knowledge of basic principles and to improve methods, techniques, and equipment which will ultimately reduce costs and improve results of studies.—M.C.M.

2300 **Cooke, Ronald.** Desert pavement: California Div. Mines and Geology Mineral Inf. Service, v. 18, no. 11, p. 197–200, illus., 1965.

The author concludes that the chief mechanism for origin of desert pavement is the upward migration of coarse fragments, aided by splitting after arrival at the surface. The wind removes finer particles, but is not an essential agent. E.S.L.

Cooper, Hilton H., Jr. *See* Bredehoeft, John D. 2679

2171 **Corbett, Marshall Keene.** Tertiary igneous petrology of the Mt. Richthofen Iron Mt. area, north central Colorado [abs.]: Dissert. Abs., v. 25, no. 10, p. 5859, 1965.

2471 **Corpus Christi Geological Society.** Upper Cretaceous asphalt deposits of the Rio Grande embayment—Annual field trip, 1965: Corpus Christi, Tex., Corpus Christi Geol. Soc., 67 p., illus., 1965.

This trip presented an opportunity to examine hydrocarbon accumulations on the surface in the area between Eagle Pass and Hondo; the rocks at three of the ten stops contain asphalt. Notes on the structural framework of the Rio Grande embayment are given, and papers are included which describe Late Paleozoic tectonic movement, igneous rocks of Uvalde County, and the stratigraphy of the Cretaceous beds in Medina County, as well as a summary of an Anacacho gas field in Uvalde County, and thermal recovery activity in South Texas. Illustrations include good photographs, sketch maps, and stratigraphic sections.—G.D.C.

Craig, Lawrence C. *See* Dunlap, John C. 2445

2324 **Cramer, Howard Ross** Annotated bibliography of Pennsylvania geology—Supplement to 1959: Pennsylvania Geol. Survey Bull. G–42, 237 p., 1965.

This bibliography of Pennsylvania geology is a continuation of, and a supplement to, the one published as Bull. G–34 in 1961, which covered literature to 1949. New aspect subheadings added are Engineering geology, Geochemical investigations, and Geophysical investigations.—E.S.L.

Crandell, D. R. *See* Moxham, R. M. 2566

Creath, Wilgus B. *See* Upshaw, Charles F. 2149

2562 **Croft, William J.** Low-temperature thermal expansion of yttrium aluminum garnet: Am. Mineralogist, v. 50, no. 10, p. 1634–1636, tables, 1965.

Coefficients of thermal expansion of pure and Nd-doped yttrium aluminum garnet were measured from room temperature down to liquid nitrogen temperature by the X-ray diffraction method. No phase transformations were observed in this range and the coefficients of both crystals were identical . . .—Author's abstract

2540 **Crowder, D. F.; Tabor, R. W.** Routes and rocks—Hiker's guide to the North Cascades from Glacier Peak to Lake Chelan: Seatle, Wash., The Mountaineers, 235 p., illus., geol. map, 1965.

The authors have participated in an intensive study of the area by the U.S. Geological Survey and combined the information they have gained about geology and trails and routes. One section, Geologic story, gives the background history of the area in layman's terms and italicized sections in the trail guides describe the geology as it is encountered.—E.S.L.

2372 **Cruff, R. W.** Cross-channel transfer of linear momentum in smooth rectangular channels: U.S. Geol. Survey Water-Supply Paper 1592-B, p. B1–B26, illus., tables, 1965.

This report describes an experimental study of shear stress distribution and cross-channel transfer of linear memomentum, from the center of a channel laterally toward the channel walls, in smooth rectangular channels. The results are

particularly applicable in engineering studies; movement of particles on the bed and banks of a stream is related directly to boundary shear stress.—W.L.G.

2570 **Culbertson, William C.** Tongues of the Green River and Wasatch Formations in the southeastern part of the Green River Basin, Wyoming, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525–D, p. D139–D143, illus., 1965.

The Luman Tongue of the Green River Formation and Niland Tongue of the Wasatch Formation, previously mapped only in the Washakie and Great Divide Basins, are here extended into the southeastern part of the Green River Basin. The Luman Tongue is 380 feet thick at the southeast corner of the basin; it thins northward and disappears about 30 miles to the north. The Niland Tongue is 280 feet thick at the southeast corner of the basin and thickens northward to a maximum of 455 feet at Sage Creek, about 13 miles to the northwest.—Author's abstract

2661 **Cummings, Bradford; Parker, Jack.** White Pine hydraulic cells, *in* Symposium on rock mechanics, 6th, Rolla, Mo., 1964, Proc.: Rolla, Mo., Univ. Missouri, p. 721–748, illus., table, 1964.

The hydraulic cell developed at White Pine, Mich., for monitoring stress changes in rock is described and illustrated. Experience has shown that the cell is not entirely suited to measurement of changes in the biaxial stress field, that the position of the cell in a pillar is critical, and that drilled holes should be smooth and clean. The cell can be set at any depth, is sturdy, and inexpensive, and can be recovered and reused.—V.S.N.

2157 **Cunningham, John Edward.** Geology of the north Tumacacori foothills, Santa Cruz County, Arizona [abs.]: Dissert. Abs., v. 25, no. 12, pt. 1, p. 7202, 1965.

2289 **Curl, Rane L.** Solution kinetics of calcite [abs.], *in* Internat. Cong. Speleology, 4th, Yugoslavia, 1965, Summ. Lectures: Ljubljana, Yugoslavia, Speleol. Soc. Yugoslavia, p. 16, 1965.

2145 **Cushman, R. V.; Krieger, R. A.; McCabe, John A.** Present and future water supply for Mammoth Cave National Park, Kentucky: U.S. Geol. Survey Water-Supply Paper 1475–Q, p. 601–647, illus., tables, 1965.

This report summarizes the available information on the quantity and quality of all sources of water in the Mammoth Cave National Park area. It describes the hydrologic system and the quantity, quality, and dependability of seven potential water sources. These include surface streams, springs, wells in alluvium, and wells in bedrock. The minimum flows of three of the potential sources are greater than the maximum water requirements in 1980.—W.L.G.

2440 **Cushman, R. V.; Pauszek, F. H.; Randall, A. D.; Thomas, M. P.; Baldwin, H. L.** Water resources of the Waterbury-Bristol area, Connecticut: U.S. Geol. Survey Water-Supply Paper 1499–J, p. J1–J86, illus., tables, 1965.

The water resources in the area of Bristol, Plymouth, Waterbury, and Wolcott, Conn., are discussed. The Naugatuck and Pequabuck Rivers and their tributaries are the principal sources of water supply, and sufficient water will be available from them for many years. Sand and gravel aquifers furnish water to some municipalities and industries; rural homes are supplied from wells in glacial deposits and bedrock. Water analyses, flow records, and well records are included.—W.L.G.

2563 **Dahl, Harry M.** Clay mineralogy of some Permian bentonites from the Delaware basin area, Texas: Am. Mineralogist, v. 50, no. 10, p. 1637–1646, illus., 1965.

These bentonite beds contain a diversity of clay mineral assemblages including randomly mixed-layered illite-montmorillonite, and mixtures of illite and montmorillonite. X-ray diffraction traces are given of five samples.—M.L.L.

2343 **Dally, Jesse L.** Application of modern geosyncline concepts to the Marathon region of West Texas, *in* The filling of the Marathon geosyncline—Symposium and

guidebook, 1964 field trip: Soc. Econ. Paleontologists and Mineralogists Permian Basin Sec. Pub. 64-9, p. 47-51, illus., 1964.

The thick upper Paleozoic flysch in the area was deposited in an exogeosyncline. This was not a part of the Ouachita orthogeosyncline, which lay further south and was the major continent-bordering geosyncline. Modern concepts of geosynclines are discussed and illustrated by diagrams. Different types have characteristic patterns, and from a study of these Dally concludes that several types of geosynclines developed in and around the Marathon area.—E.S.L.

2326 **Dane, Carle H.; Bachman, George O.** Geologic map of New Mexico: Washington, D. C., U.S. Geol. Survey, 2 sheets, scale 1:500,000, 1965.

The map was prepared with the cooperation of the New Mexico Institute of Mining and Technology, State Bureau of Mines and Mineral Resources Division, and the University of New Mexico, Department of Geology. An insert map shows the 173 sources of data listed on sheet 1; sheet 2 contains the explanatory chart for the map and a bibliography.—M.C.M.

Dante, John H. *See* Frizzell, Don L. 2191

2158 **Darby, David Grant.** Ecology and taxonomy of Ostracoda in the vicinity of Sapelo Island, Georgia [abs.]: Dissert. Abs., v. 25, no. 12, pt. 1, p. 7202-7203, 1965.

2528 **Davis, Stanley N.; Moore, George W.** Semidiurnal movement along a bedrock joint in Wool Hollow Cave, California: Natl. Speleol. Soc. Bull., v. 27, no. 4, p. 133-142, illus., 1965.

A 22-hour record of strain has been obtained from three mutually perpendicular transducing cells across a joint in the wall of this cave in Calaveras County, in the hope of determining the causes of strain. The joint, which strikes N. 50° E. and dips 27° NW., cuts recent travertine as well as bedrock. The slippage showed two maxima and two minima roughly coincident with theoretical earth tides. A seismic disturbance, with an amplitude of 0.01 micron, from the Moluccan earthquake of March 21, 1965, was superimposed on the slower tidal deflections during a five-hour period, and it appears to have caused abrupt deflections as large as 0.03 micron, indicated by steps on the strain record.—*from* Authors' abstract

2290 **Deal, Dwight E.** Origin and secondary mineralization of caves in the Black Hills of South Dakota, USA [abs.], *in* Internat. Cong. Speleology, 4th, Yugoslavia, 1965, Summ. Lectures: Ljubljana, Yugoslavia, Speleol. Soc. Yugoslavia, p. 17, 1965.

Dean, Walter E., Jr. *See* Kirkland, Douglas W. 2507

2624 **Deffeyes, Kenneth S.** Carbonate equilibria—A graphic and algebraic approach: Limnology and Oceanography, v. 10, no. 3, p. 412-426, illus., table, 1965.

Graphic solutions for a wide variety of carbonate-equilibrium problems can be obtained by using the total carbonate carbon and alkalinity as abscissa and ordinate. At any point, the carbonate system is completely defined and the pH, carbon dioxide pressure, and bicarbonate and carbonate concentrations can be presented as contours. An algebraic treatment that is equivalent to graphic solutions can be used either to obtain greater precision or to work with different equilibrium constants.—*from* Author's abstract

2495 **DeLory, F. A.; Gass, A. A.; Wong, W. W.** Measured pore pressures used for the control of two-stage construction of an embankment [with French abs.]: Canadian Geotech. Jour., v. 2, no. 3, p. 216-226, illus., tables, discussion p. 227-233, 1965.

A double-track railway embankment from 21-33 feet high was constructed around the northern perimeter of Metropolitan Toronto, Ontario. Two-stage construction was necessary because of soft foundation soil. Effective stress methods of analysis were used and piezometers were installed in the foundation soil. Pore pressures measured during the first-stage loading indicated that the second stage could be

added about a year after the first. Measurements continued during the second-stage loading. The embankment was successfully completed.—E.S.L.

Denny, M. V. *See* Drake, Avery Ala, Jr. 2573

2391 **Denson, Norman M.** Miocene and Pliocene rocks of central Wyoming, *in* Changes in stratigraphic nomenclature by the U.S. Geological Survey, 1964: U.S. Geol. Survey Bull. 1224–A, p. A70–A74, illus., table, 1965.

2424 **Denson, Norman M.; Zeller, Howard D.; Stephens, E. Vernon.** South Pass Formation on the southwest flank of Wind River Mountains, Wyoming, *in* Changes in stratigraphic nomenclature by the U.S. Geological Survey, 1964: U.S. Geol. Survey Bull. 1224–A, p. A27–A29, illus., 1965.

2663 **Detterman, Robert L.; Reed, Bruce L.; Lanphere, Marvin A.** Jurassic plutonism in the Cook Inlet region, Alaska, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525–D, p. D16–D21, illus., tables, 1965.

Potassium–argon determinations on hornblende and biotite indicate an age of 170 m.y. for emplacement of the Aleutian Range batholith; geologic mapping suggests emplacement between Early Jurassic and early Middle Jurassic time. The age of this batholith agrees closely with the age of the Kosina batholith in the Talkeetna Mountains about 250 miles to the northeast.—Authors' abstract

2666 **Detterman, Robert L.; Reed, Bruce L.; Rubin, Meyer.** Radiocarbon dates from Iliamna Lake, Alaska, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525–D, p. D34–D36, illus., 1965.

A radiocarbon date of 8,520±350 years B.P. from a lacustrine sand deposit in a terrace at the west end of Iliamna Lake establishes a minimum age for the second major advance of the Brooks Lake Glaciation. The advance must be considerably older than 8,520 years, as other terraces are cut into the moraine as much as 49 feet above the dated terrace.—Authors' abstract

2594 **Dickinson, Robert G.** Landslide origin of the type Cerro Till, southwestern Colorado, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525–C, p. C147–C151, illus., 1965.

Geologic study of the hummocky and bouldery surficial debris comprising the type Cerro Till indicates that the material was deposited by mass-wasting processes, primarily landsliding, instead of by a piedmont glacier. The name Cerro Till is abandoned because till does not occur in the type area.—Author's abstract

Dietrich, J. W. *See* Maxwell, R. A. 2266

2260 **Dobell, Joseph P.** The Missoula Group of the Belt series, *in* Geology of the Flint Creek Range, Montana—Billings Geol. Soc., 16th Ann. Field Conf. 1965: Billings, Mont., Billings Geol. Soc., p. 98–107, illus., table, 1965.

This investigation covers the type localities for the five formations of the Precambrian Missoula Group as defined by Clapp and Deiss (1931). A table compares their subdivisions with those used in this report. Each formation is described, and the structure and relations of the Group with the Cambrian discussed briefly.—E.S.L.

2449 **Donaldson, J. A.; Jackson, G. D.** Archaean sedimentary rocks of North Spirit Lake area, northwestern Ontario: Canadian Jour. Earth Sci., v. 2, no. 6, p. 622–647, illus., tables, 1965.

These rocks show litle evidence of having been derived from associated Archean volcanic rocks. Instead, compositions of the sediments, such as a remarkably high content of clastic quartz, reflect significant sedimentary and (or) granitoid provenance. Quartzose sandstones commonly regarded as atypical of the Archean are abundant in northwestern Ontario. Major unconformities may exist not only between sedimentary and volcanic units, but also between these units and older

granitoid rocks. A large section of the paper is devoted to petrography, with notes on nomenclature.—E.S.L.

2285 **Donnelly, Thomas W.** Sea-bottom morphology suggestive of post-Pleistocene tectonic activity of the eastern Greater Antilles: Geol. Soc. America Bull., v. 76, no. 11, p. 1291–1294, illus., 1965.

Bathymetric and continuous seismic-profiler ("sparker") observations show that a presumably Pleistocene erosion surface in the Greater Antilles has been deformed by post-Pleistocene faulting, some of which must be very recent. A maximum average rate of 5 mm/yr for post-Pleistocene uplift is estimated.—Author's abstract

2229 **Dowling, John Joseph.** Travel-time curves from velocity distributions with applications to the Earth's upper mantle [abs.]: Dissert. Abs., v. 25, no. 11, p. 6691–6692, 1965.

2573 **Drake, Avery Ala, Jr.; Denny, M. V.; Hamlin, Howard P.** Evaluation of the Martinsburg shale and two younger formations as sources of lightweight aggregate in the Delaware River area, Pennsylvania-New Jersey, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-D, p. D156–D162, illus., tables, 1965.

Five samples of slate from different stratigraphic intervals within the Martinsburg Shale and one sample each from the New Scotland Limestone and the Esopus Shale were tested as potential raw materials for production of bloated rotary-kiln-fired lightweight aggregate. The expanded products that formed in the muffle- and rotary-kiln firing tests of the Martinsburg material were found to compare favorably with selected commercial lightweight aggregates. Muffle-kiln firing of shale from the New Scotland Limestone and the Esopus Shale, however, failed to cause it to expand notably, and consequently resulted in products too heavy to be usable as lightweight aggregate.—Authors' abstract

2233 **Driscoll, Egbert G.** Dimyarian pelecypods of the Mississippian Marshall sandstone of Michigan: Palaeontographica Americana, v. 5, no. 35, p. 67–128, illus., tables, 1965.

Twenty-five species of *Ctenodonta, Cypricardella, Grammysia, Nuculopsis, Palaeoneilo, Palaeosolen, Parallelodon, Polidevcia, Prothyris, Sanguinolites, Schizodus, Solenomorpha,* and *Sphenotus* are described, including four new species and one new subspecies. While most species are from the Marshall Sandstone, related species from the underlying Coldwater Shale of Michigan and from the Waverly Group of Ohio are discussed also. The Marshall is correlated with members of the Cuyahoga and Logan Formations of the Waverly Group and is tentatively Osagean in age. Similar faunas in south-central Ohio and the Michigan basin suggest possible migration between these areas in Marshall time.—V.M.J.

Drummond, Kenneth M. *See* Conley, James F. 2238

2322 **Duncan, Donald C.; Swanson, Vernon E.** Organic-rich shale of the United States and world land areas: U.S. Geol. Survey Circ. 523, 30 p., illus., tables, 1965.

A review of organic-rich shale deposits in the United States and world land areas was conducted to estimate the energy and oil potential of these little-used resources. . . . Details of these estimates are contained in discussions of the resources of the United States and six continental land areas.—Authors' abstract

Duncan, Helen. *See* Poole, F. G. 2388

2467 **Duncan, John R., Jr.** Effects of water table and tide cycle on swash-backwash sediment distribution and beach profile development [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1759–1760, 1965.

2445 **Dunlap, John C.; Bergquist, Harlan R.; Craig, Lawrence C.; Overstreet, Elizabeth F.** Bauxite deposits of Tennessee: U.S. Geol. Survey Bull. 1199-L, p. L1–L37, illus., tables, geol. maps, 1965.

A description is given of bauxite deposits in the Chattanooga, Indian Mound, and Elizabethton districts of Hamilton, Stewart, and Carter Counties, respectively. All the deposits in these three counties probably originated as transported debris deposited in sinkholes and solution channels, and all occur in areas underlain by Upper Cambrian dolomite.—W.L.G.

2356 **Durham, David L.; Addicott, Warren O.** Pancho Rico Formation, Salinas Valley, California: U.S. Geol. Survey Prof. Paper 524–A, p. A1–A22, illus., table, 1965.

The Pancho Rico Formation of Pliocene age in Salinas Valley, Calif., is a series of sandy marine strata interbedded with finer grained rocks. The lithologic character, stratigraphic relations, and thickness of the Formation are discussed, along with paleontologic determinations, correlation of strata, molluscan paleoecology and paleogeography. Previous nomenclature applied to late Miocene and Pliocene strata in this area and that adopted here are shown in a chart. Larger invertebrates, primarily gastropods and pelecypods, are tabulated; those forms that are diagnostic or strongly suggestive of Pliocene age are listed separately and discussed. Warm water indicators in the early Pliocene of the Salinas Valley area suggest a Pliocene seaway connected Salinas Valley to Santa Maria basin on the south.—V.S.N.

2568 **Durham, David L.** Evidence of large strike–slip displacement along a fault in the southern Salinas Valley, California, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525–D, p. D106–D111, illus., 1965.

Offset of the limits of deposition of the Pancho Rico and Santa Margarita Formations along a fault in the southern Salinas Valley indicates right–lateral strike–slip displacement of at least 11 miles. The faulting explains the juxtaposition of contemporaneous but unlike sequences of upper Miocene and Pliocene strata exposed near the Nacimiento River. It occurred after deposition of at least part of the Paso Robles Formation of Pliocene and Pleistocene(?) age.—Author's abstract

2481 **Eakin, Thomas E.; Moore, Donald O.; Everett, Duane E.** Water resources appraisal of the upper Reese River valley, Lander and Nye Counties, Nevada: Nevada Dept. Conserv. and Nat. Resources Water Resources—Reconn. Ser. Rept. 31, 47 p., illus., tables, 1965.

An average of about 37,000 acre–feet of water is discharged annually from the ground–water reservoir of this area by evapotranspiration; the preliminary estimate of perennial yield is equivalent to the estimated natural discharge. Streamflow as runoff from the mountain areas was estimated to average about 36,000 acre–feet a year, part of which enters the ground–water reservoir by infiltration into the valley fill after leaving the mountains, some infiltrating into the bedrock, and the remaining lost by evapotranspiration. Most of the runoff and ground–water recharge is derived from precipitation on the mountains. Ground–water storage is many times the average annual natural discharge from the valley.—M.C.M.

2622 **Ebanks, William James, Jr.** Structural geology of the Gass Peak area, Las Vegas Range, Nevada [abs.]: Houston Geol. Soc. Bull., v. 8, no. 4, p. 22, 1965.

2542 **Eggleton, Richard Anthony.** The crystal structure of stilpnomelane [abs.]: Dissert. Abs., v. 25, no. 10, p. 5976–5977, 1965.

2549 **Ehinger, R. F.; Goers, J. W.; Hall, M. L.; Harris, W. L.; Illich, H. A.; Petkewich, R. M.; Pevear, D. R.; Stuart, C. J.; Thompson, G. R.** Clay mineralogy of Mesozoic sediments in the vicinity of Drummond, Montana, *in* Geology of the Flint Creek Range, Montana—Billings Geol. Soc., 16th Ann. Field Conf. 1965: Billings, Mont., Billings Geol. Soc., p. 58–66, tables, 1965.

Data are reported from a preliminary survey of the clay mineralogy of the Jurassic and Cretaceous rocks near Drummond, Mont. The results are shown in a diagram. The clay mineralogy of the Jurassic is compatible with a detrital origin and marine environment. The Cretaceous seems to have had a more variable source and a varying depositional environment. The authors wish to emphasize that these

tentative interpretations were made on the basis of very few samples, 30 for over 20,000 feet of section.—E.S.L.

2144 **Ehlers, Ernest G.; Stiles, David V.** Melanterite–rozenite equilibrium: Am. Mineralogist, v. 50, no. 9, p. 1457–1461, illus., 1965.

Altered pyrite from the Middle Kittanning (No. 6) coal, Vinton County, Ohio, was encrusted with melanterite, rozenite ($FeSO_4 \cdot 4H_2O$), and halotrichite. The reaction of melanterite to rozenite was reversible, occurring at about 74 and 79 percent relative humidity at 20 and 25°C respectively.—E.H.R.

Ekren, E. B. *See* Sargent, K. A. 2385

Ekren, E. B. *See* Anderson, R. E. 2571

2342 **Ellison, Samuel P., Jr.** Conodonts of the Gaptank Formation, *in* The filling of the Marathon geosyncline—Symposium and guidebook, 1964 field trip: Soc. Econ. Paleontologists and Mineralogists Permian Basin Sec. Pub. 64-9, p. 45–46, illus., 1964.

More than 100 samples were taken at two to five ft intervals through the section at the type locality of the Gaptank Formation. Conodonts were found in only eight of the samples, in residues from limestone. Location of the occurrences in the section is shown diagrammatically, the samples are described, and conodonts listed. Age interpretations agree with those from fusulinids.—E.S.L.

Elston, D. P. *See* Poole, F. G. 2386

2658 **Emery, C. L.** In situ measurements applied to mine design, *in* Symposium on rock mechanics, 6th, Rolla, Mo., 1964, Proc.: Rolla, Mo., Univ. Missouri, p. 218–230, illus., tables, 1964.

A program of rock mechanics study and the analysis and application of data to mine design is outlined briefly for a mine operating at depths of about 2,500 feet in Silurian sediments overlain by Devonian strata. Both laboratory tests on rock samples, and in situ mine tests are discussed.—V.S.N.

2596 **Emery, K. O.** Some potential mineral resources of the Atlantic continental margin, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-C, p. C157–C160, illus., 1965.

Preliminary findings from a current geological investigation indicates that the continental shelf and upper part of the continental slope off the Atlantic coast of the United States may be the site of large deposits of construction sand, phosphorite, manganese oxide, and petroleum. The sand covers most of the continental shelf; the phosphorite occurs near the top of the continental slope and its southward extension inshore of the Blake Plateau; and manganese nodules are common on the Blake Plateau. Petroleum source beds and structures appear to be most favorable along a seaward extension of the Cape Fear Arch, the outer part of the continental shelf from south Boston northeast probably to Grand Banks of Newfoundland, and a probable fault zone southeast of New York City.—Author's abstract

Emmett, William W. *See* Leopold, Luna B. 2304

Empson, F. M. *See* Bradshaw, R. L. 2655

2597 **Engel, Celeste G.; Chase, Thomas E.** Composition of basalts dredged from seamounts off the west coast of Central America, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-C, p. C161–C163, illus., table, 1965. Two alkali basalts and a third, intermediate in composition between tholeiitic and alkali basalts, have been dredged from the surficial parts of three submarine volcanoes on the Cocos Ridge, eastern Pacific Ocean. The two alkali basalts contain (in weight percent, calculated water free): SiO_2, 44.6; Na_2O+K_2O, 4.8 to 5.8; and appreciable amounts of the trace elements Ba, Sr, and Zr. The intermediate type

contains: SiO_2, 48.8; Na_2O+K_2O, 3.7; and smaller amounts of most trace elements except Cu. Alkali basalts, similar to those from the Cocos Ridge, form the apical parts of most large volcanoes throughout the oceans.—Authors' abstract

2286 **Evans, Bernard W.** Pyrope garnet—Piezometer or thermometer?: Geol. Soc. America Bull., v. 76, no. 11, p. 1295–1300, 1965.

The pyrope content of garnet is only an estimate of minimum pressure of formation. The growth of garnet at the expense of a coexisting silicate invariably increases the Mg/Fe ratio of the garnet, but does so with increase of temperature in some cases and increase in pressure in other cases.—R.G.Y.

2428 **Evans, Hilton B.** Factors influencing permeability and diffusion of radon in synthetic sandstones [abs.]: Dissert. Abs., v. 25, no. 12, pt. 1, p. 7321, 1965.

2374 **Evenson, R. E.** Suitability of irrigation water and changes in ground-water quality in the Lompoc subarea of the Santa Ynez River basin, Santa Barbara County, California: U.S. Geol. Survey Water-Supply Paper 1809-S, p. S1–S20, illus., table, 1965.

Analyses of water samples collected since 1934 from some of the irrigation wells in the Lompoc subarea of the Santa Ynez River valley have shown a gradual deterioration in the chemical quality of the water. . . . The influence of recycled irrigation water is indicated by increased concentrations of chloride and sulfate in a ratio of 1:2. Inflow of high-chloride low-sulfate connate water is indicated by increased chloride concentration correlated with little or no change in sulfate concentration. Peak chloride concentrations in three local areas are probably the result of inflow of connate water. Furthermore, ground-water gradients in each of the local areas are favorable for inflow from the consolidated rocks.—Author's abstract

2513 **Everett, D. E.; Rush, F. Eugene.** Water resources appraisal of Lovelock Valley, Pershing County, Nevada: Nevada Dept. Conserv. and Nat. Resources Water Resources—Reconn. Ser. Rept. 32, 40 p., illus., tables, 1965.

The bulk of the total water supply available to Lovelock Valley is from the Humboldt River. Alluvial deposits (maximum thickness unknown) serve as a storage reservoir for ground water in the valley. Most available ground water of suitable chemical quality for agricultural and domestic uses occurs in alluvium in the Oreana area. In lower Lovelock Valley where virtually all the irrigation occurs, ground water is largely of unsuitable chemical quality and little is used. Ground water in the upper valley is of suitable quality for most uses, but recharge from local sources is small. An average of about 50,000 acre-feet per year of good quality flood water has wasted to the Humboldt Sink.—M.C.M.

Everett, Duane E. *See* Eakin, Thomas E. 2481

2172 **Eyer, Jerome Arlan.** Stratigraphy and micropaleontology of the Gannett Group of western Wyoming and southeastern Idaho [abs.]: Dissert. Abs., v. 25, no. 10, p. 5860, 1965.

Fair, C. L. *See* Heindl, L. A. 2447

Fairbanks, Harold W. *See* Storms, W. H. 2490

2509 **Farnham, R. S.** Peat resources of Minnesota—Rept. of Inventory No. 1, West central lakes bog, St. Louis Co., Minnesota: St. Paul, Minn., Office Iron Range Resources and Rehabilitation, 20 p., illus., tables, 1964.

Peat is widely distributed throughout Minnesota but the types best suited for commercial development are located mainly in the large bog areas in the north, especially in the old glacial lake basins. In the area of this report, the thick stratum of sphagnum moss peat is very porous and highly permeable, making drainage possible, and the uniform quality permits easy drying and economical harvesting.

The bog contains at least 1,300 acres of peat over 5 feet in thickness and about 400 acres over 8 feet in thickness. Tables contain analyses of 677 samples.—M.C.M.

2510 **Farnham, R. S.; Grubich, Donald N.** Peat resources of Minnesota—Rept. of Inventory No. 2, Cook bog, St. Louis County, Minnesota: St. Paul, Minn., Office Iron Range Resources and Rehabilitation, 28 p., illus., tables, 1965.

The total extent of peat in the Cook bog exceeds 6,000 acres, representing a wide variety of types. Some areas contain good quality sphagnum moss peat suitable for a harvesting operation; drainability should be very good. Tables show analyses of peat from 98 sites, and surface vegetation and relative water-table levels at selected sampling sites.—M.C.M.

2321 **Fellows, L. D.** Cutters and pinnacles in Greene County, Missouri: Natl. Speleol. Soc. Bull., v. 27, no. 4, p. 143–150, illus., 1965.

Cutters, incisions in bedrock formed by leaching at the bedrock–regolith contact, and pinnacles, upward projections of bedrock between cutters, have developed in the Burlington Limestone in Greene County, Mo. They are present in the subsurface and can be observed only in excavations. The origin of cutters by leaching along the regolith contact is discussed in detail. The role of the cherty beds is examined.—E.S.L.

2588 **Fernald, Arthur T.** Glaciation in the Nabesna River area, upper Tanana River valley, Alaska, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525–C, p. C120–C123, illus., 1965.

Morainal deposits define two major glaciations—the Black Hills Glaciation of Illinoian age and the Jatahmund Late Glaciation of Wisconsin age. Nonglacial terrace deposits, consisting of an upper unit of Wisconsin age (W–1174; 25,800 years B.P.) and a lower unit thought to be of Sangamon age (W–976; older than 42,000 years), are correlated with the glacial sequence.—Author's abstract

2589 **Fernald, Arthur T.** Recent history of the upper Tanana River lowland, Alaska, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525–C, p. C124–C127, illus., 1965.

Twenty radiocarbon analyses provide dates for the following events that postdate late Quaternary glaciation and eolian activity: (1) Stabilization of dunes initiated in late Wisconsin and postglacial times probably was completed more than 5,000 years ago. (2) Alluvial–colluvial filling along lowland borders began 10,500–6,000 years ago and continues today. (3) Deposition of fluvial–lacustrine sediments in the lowland has become widespread within the last 3,000 years.—Author's abstract

Ferreira, Carlos P. *See* Rosholt, John N., Jr. 2604

2603 **Ficke, John F.** Seasonal erasure of thermal stratification in Pretty Lake, Indiana, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525–C, p. C199–C202, illus., 1965.

Data on temperature and concentration of dissolved oxygen in a small Indiana lake were used in describing the erasure of stratification of the lake water during the warm autumn of 1963. A measurable thermocline was observed to drop within a few feet of the bottom before it was erased in late November. Upon turnover of lake water the uniform lake temperature was about 0.6°C higher than the temperature of the hypolimnion while the lake was stratified.—Author's abstract

Fidler, Richard E. *See* Norris, Stanley E. 2639

Finch, C. B. *See* Harris, L. A. 2142

2347 **Finlayson, C. Pratt; Oder, Charles R. L.; Coker, Alfred E.** Geologic map of the Talbott quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 163–NW, scale 1:24,000, separate text, 1965.

The Talbott quadrangle is in the northeastern part of the Mascot–Jefferson City zinc district, but no zinc mines are presently active. The major zinc producing horizons have been extensively test drilled, but the results are not available. Rocks of the Knox and Chickamauga Groups and limestone of the Conasauga Group are well suited for ordinary crushed stone uses. Abundant reserves of chert are present, generally in areas underlain by the Knox Group.—M.C.M.

2348 **Finlayson, C. Pratt.** Geologic map of the Powder Springs quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 154–SW, scale 1:24,000, separate text, 1965.

The only mineral resources that have been mined in the Powder Springs quadrangle are limestone and dolomite and abundant reserves are present in rocks of the Knox and Chickamauga Groups. Potential resources are lead, zinc, hematite, sand, marble, shale or clay, and chert.—M.C.M.

2349 **Finlayson, C. Pratt.** Geologic map of the Joppa quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 155–NE, scale 1:24,000, separate text, 1965.

Rocks of the Knox Group and Maynardsville and Maryville Limestones are well suited for ordinary crushed-stone uses and abundant reserves of limestone and dolomite are present in the Joppa quadrangle. Potential resources are shale, clay, and chert.—M.C.M.

2564 **Fisher, D. Jerome.** Dickinsonites, fillowite, and alluaudites: Am. Mineralogist, v. 50, no. 10, p. 1647–1669, illus., tables, 1965.

Crystallography, unit cell data, thermal analyses, infrared studies, and an interpretation of analyses, chiefly on a dry basis, are given for these sodium manganese–iron phosphates. If fresh, the minerals usually contain small portions of water, mostly less than 2 percent. Infrared studies show alluaudite and arrojadite lack essential bonded or unbonded OH.—M.L.L.

Fisher, Donald W. *See* Slack, Keith V. 2602

Fitch, F. G. *See* Miller, J. A. 2556

2415 **Flawn, Peter T.** Whither the Ouachitas? [abs.]: Tulsa Geol. Soc. Digest, v. 32, p. 172, 1964.

2544 **Flawn, Peter T.** The regional setting of the Marathon salient, *in* The filling of the Marathon geosyncline—Symposium and guidebook, 1964 field trip: Soc. Econ. Paleontologists and Mineralogists Permian Basin Sec. Pub. 64-9, p. 9-11, illus., revised 1964; originally published 1961.

This paper is modified from the first four pages of *The Ouachita System*, and traces this belt of deformed Paleozoic rocks from the Ouachita Mountains into Mexico. The Marathon basin is located in a structural salient similar to the Ouachita. The structure, tectonics, and metamorphism are discussed.—E.S.L.

2670 **Fleischer, Michael.** Composition of magnetite as related to type of occurrence, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525–D, p. D82–D84, tables, 1965.

Compilation of 12 analyses of magnetite from veins in basaltic trap rock shows a characteristic high MgO content, indicative of samples representing the greater part of the isomorphous series magnetite–magnesioferrite. Many samples are probably magnesioferrite rather than magnetite, and are characterized by having a much lower content of TiO_2 than igneous magnetite from diabase and basalt. Eleven analyses of magnetite from alkalic rocks and carbonatite show a generally high content of MgO, Al_2O_3, and MnO; the composition of these samples is such that they should contain exsolved hercynite or spinel. . . .—Author's abstract

2422 **Forgotson, James M.** Current applications of computers by exploration geologists [abs.]: Tulsa Geol. Soc. Digest, v. 32, p. 177, 1964.

Foster, J. B. *See* Musgrove, R. H. 2477

2559 **Fraser, Donald M.** Reminiscences of Paul F. Kerr: Am. Mineralogist, v. 50, no. 10, p. 1552, 1965.

Reminiscences are given of P. F. Kerr by his first doctorate student.—B.C.H.

2382 **Freeman, John C.** The Conley field, Hardeman County, Texas, *in* Symposium on the Arbuckle: Tulsa Geol. Soc. Digest, v. 32, p. 126–130, illus., 1964.

The discovery of the Conley field by seismic work, the nature of the trap, and lithology of the area are described, reservoir data and production information given, and three structure contour maps are included.—E.S.L.

2383 **Freeman, John C.** The West Odell Field, Wilbarger County, Texas, *in* Symposium on the Arbuckle: Tulsa Geol. Soc. Digest, v. 32, p. 131–135, illus., 1964.

A brief discussion of the oil field is given and three structure contour maps and a well log are included.—E.S.L.

2384 **Fritts, Crawford E.** Nomenclature and age of formations in the Ansonia quadrangle, Fairfield and New Haven Counties, Connecticut, *in* Changes in stratigraphic nomenclature by the U.S. Geological Survey, 1964: U.S. Geol. Survey Bull. 1224-A, p. A30–A32, 1965.

2191 **Frizzell, Don L.; Dante, John H.** Otoliths of some early Cenozoic fishes of the Gulf Coast: Jour. Paleontology, v. 39, no. 4, p. 687–718, illus., 1965.

Nineteen new species of teleost fishes, based on otoliths, are added to 34 previously known early Cenozoic species. One family (Osteoglossidae) that is represented in early Cenozoic strata is absent in Recent faunas of the Gulf of Mexico; 10 families are inshore forms; one family (Myctophidae) is bathypelagic; a family that includes uncertainly placed beryciforms is either bathypelagic or benthonic. Terminology of the saccular otolith (sagitta) is illustrated, and terms for the utricular otolith (lapillae) are proposed.—F.C.W.

2676 **Frondel, Clifford; Klein, Cornelis.** Exsolution in franklinite: Am. Mineralogist, v. 50, no. 10, p. 1670–1680, illus., 1965.

Metallographic, x-ray diffraction and electron micro-probe observations have been made on exsolution growths of hetaerolite, gahnite and hematite in analyzed specimens of franklinite from Franklin and Sterling Hill, New Jersey. The hetaerolite exsolution when referred to the equilibrium diagram of Mason (1947) for the system Fe_3O_4–Mn_3O_4–$ZnFe_2O_4$ indicates a minimum temperature of formation of 650°–700°C for the initial homogeneous phase.—Authors' abstract

Frost, I. C. *See* Tourtelot, H. A. 2580

2237 **Furbish, William J.** Laumontite-leonhardite from Durham County, N. C.: Southeastern Geology, v. 6, no. 4, p. 189–200, illus., table, 1965.

Two differing occurrences of laumontite are discussed relative to their origin in either basic igneous rock or under incipiently metamorphic conditions. The weathering process and clay product, when a high calcium and magnesium and low potassium concentration exists in the weathering solutions, are considered. Physical properties of cleavage and fracture are shown to be partially dependent upon dehydration and possibly also on the variation of composition. The DTA pattern of material from one of the occurrences of laumontite is compared with parallel static X-ray diffraction results. It is also compared with Koizumi's dehydration curve for laumontite with a high degree of correlation occurring.—Author's abstract

2159 **Gardner, John Kelsey.** Earthquakes in the Walker Pass region, California, and their relation to the tectonic of the southern Sierra Nevada [abs.]: Dissert. Abs., v. 25, no. 12, pt. 1, p. 7203, 1965.

2214 **Garlick, George Donald.** Oxygen isotope ratios in coexisting minerals of regionally metamorphosed rocks [abs.]: Dissert. Abs., v. 25, no. 11, p. 6533, 1965.

Gaskill, D. L. *See* Young, L. L. 2439

Gass, A. A. *See* DeLory, F. A. 2495

Gazin, C. L. *See* Rohrer, W. L. 2684

2626 **Gees, Rudolf A.** Moment measures in relation to the depositional environments of sands: Eclogae Geol. Helvetiae, v. 58, no. 1, p. 209–213, illus., 1965.

The significance and value of measures of grain size frequency distributions in sediments to identify depositional environments are examined. Moment measures of textural parameters (the mean, standard deviation, skewness, kurtosis) on 58 river sands from Switzerland and 60 beach sands from the California coast are reported. Three graphs were made, using an IBM 1620 computer and an on line automatic Calcomp X–Y plotter, which plot skewness against kurtosis, skewness against sorting, and the mean against sorting. Results are compared with those of Friedman (1961), but unlike his, indicate that moment measures are not reliable when applied to determination of depositional environments of sandy sediments. They might prove successful, however, if applied to environments of small extent.—V.S.N.

2206 **Gerharz, Reinhold.** Absorption structures in the visible reflection spectrum of minerals: Econ. Geology, v. 60, no. 8, p. 1721–1725, illus., 1965.

Narrow and faint absorption lines have been observed in the reflectance spectra of monazite, willemite, scheelite, and feldspar. The wavelength of these lines was measured by visual and photographic means, but their cause of origin was not established.—Author's abstract

Geurin, J. W. *See* Callahan, J. T. 2438

2543 **Gill, Harold E.; Vecchioli, John.** Availability of ground water in Morris County, New Jersey: New Jersey Div. Water Policy and Supply Spec. Rept. 25, 56 p., illus., tables, geol. map, 1965.

Ground water in Morris County occurs in the voids in the unconsolidated sediments and in fractures of the bedrock, the greatest quantity presently withdrawn being from the unconsolidated stratified drift deposits. The aquifers in the Precambrian, Triassic, and Paleozoic rocks also yield substantial quantities in decreasing order. Stratified drift deposits and lowland bedrock areas which are overlain by substantial thickness of terminal moraine, till, or stratified drift are most suitable aquifers for future development. The areas where generally only small to moderate supplies can be developed occur south of the terminal moraine and in the upland areas in the north and northwestern portions of the County.—*from* Authors' abstract

2660 **Gilley, James L.; Sorcic, Rudolph; Zona, Anthony.** Progress in the application of encapsulated cells in a coal mine subject to coal bursts, *in* Symposium on rock mechanics, 6th, Rolla, Mo., 1964, Proc.: Rolla, Mo., Univ. Missouri, p. 649–667, illus., 1964.

An encapsulated hydraulic cell, developed by the U.S. Bureau of Mines, for measurement of pressure changes in coal in situ is described and illustrated. The cell is designed to give information which may be used to reduce the frequency and severity of coal bursts in mines. Operational techniques developed during studies in a coal mine in West Virginia and data obtained in the mine are presented.—V.S.N.

2441 **Gilluly, James; Masursky, Harold.** Geology of the Cortez quadrangle, Nevada: U.S. Geol. Survey Bull. 1175, 117 p., illus., tables, geol. maps, 1965.

The stratigraphy, structure, and economic geology of the Cortez quadrangle, in north-central Nevada, are discussed. The area is of particular interest because of the formerly active bonanza silver cap at Cortez and because of the exposure of

the Roberts thrust, one of the great structures of the Cordillera and critical to an understanding of Cordilleran evolution. Paleozoic, Mesozoic, and Cenozoic strata and Tertiary volcanics are exposed in the area. The Roberts thrust is latest Devonian or Early Mississippian in age. Basin and Range faults originated in Pliocene and have been active in post-Pleistocene. Major polymetallic sulfide ores at Cortez are chiefly manto deposits in the Hamburg Dolomite, although large tonnages have been obtained from fissure veins associated with quartz porphyry dikes. V.S.N.

2407 **Gilreath, J. H.** Use of dipmeter as an aid in integrating subsurface, structural, and depositional features [abs.]: Tulsa Geol. Soc. Digest, v. 32, p. 166, 1964.

2330 **Girdler, R. W.** The formation of new oceanic crust, *in* A symposium on continental drift: Royal Soc. London Philos. Trans., ser. A, v. 258, no. 1088, p. 123–136, illus., table, 1965.

If continental drift is accepted it is necessary to invoke a mechanism for the evolution of new oceanic crust. The Red Sea and Gulf of California and the seismically active oceanic rifts with which they are in continuity are inferred to be regions where new oceanic crust is forming. Tensional rift zones which are regions of shallow seismicity help locate regions of rising mantle currents, and deep and intermediate earthquake regions help locate descending currents. A possible mechanism for the evolution of new oceanic crust is given, based on the isostatic equilibrium of oceans and continents.—D.B.V.

Goebel, Edwin D. *See* Merriam, Daniel F. 2379

Goers, J. W. *See* Ehinger, R. F. 2549

Goodfield, June. *See* Toulmin, Stephen. 2306

Gordon, Mackenzie, Jr. *See* Poole, F. G. 2388

2621 **Gould, Stephen Jay.** Is uniformitarianism necessary?—A reply [to discussion by C. R. Longwell, 1965]: Am. Jour. Sci., v. 263, no. 10, p. 919–921, 1965.

In reply to C. R. Longwell's discussion (ibid., p. 918–919) of Gould's 1965 paper it is remarked that the study of present processes is necessary to understand nature's past operations, but the term "uniformitarianism" should be dropped.—M.H.K.

2472 **Grace, K. A.** The determination of the gallium-aluminum ratio in rocks and the possible petrogenic significance of this ratio [abs.], *in* Guidebook of the Ruidoso country—New Mexico Geol. Soc., 15th Field Conf. 1964: Socorro, New Mexico Bur. Mines and Mineral Resources, p. 187, 1964.

Gray, K. E. *See* Podio, Augusto L. 2143

Green, Jack. *See* Poldervaart, Arie. 2558

2197 **Green, Morton.** New late Miocene locality in South Dakota: Jour. Paleontology, v. 39, no. 1, p. 103–107, illus., 1965.

An outcrop of silt- and mudstone in Jerauld County, S. Dak., has produced a small collection of fossil vertebrates, including *Monosaulax* sp. and *Merychippus* sp. These strata, heretofore doubtfully referred to the Oligocene–Miocene and the Pliocene by authors, can now be dated as late Miocene (Barstovian), and are equivalent to the Valentine Formation. The fossil assemblage is named the Wessington Springs local fauna.—F.C.W.

Greenlee, David W. *See* Pearson, Bruce. 2250

2160 **Gresens, Randall Lee.** A geochemical and structural study of metasomatic formation of certain pegmatites [abs.]: Dissert. Abs., v. 25, no. 12, pt. 1, p. 7204, 1965.

2652 **Gresseth, E. W.** Determining the maximum principal stress direction by analyzing in situ failure of anisotropic heterogeneous rock, *in* Symposium on rock mechanics, 6th, Rolla, Mo., 1964, Proc.: Rolla, Mo., Univ. Missouri, p. 1–22, illus., 1964.

Rock joints, fractures, and bedding were analyzed on three levels of the Star mine, Burke, Idaho, to determine the direction of the maximum principal stress axis. Data on orientations, type of rupture, and relative displacements were examined. Equal area projections were used to group and classify the systems, and the directions of the principal stress axes were determined by the strain ellipsoid method. Two periods of deformation were in evidence. The first resulted in folding and faulting, with the principal component of ground force in an east–west direction. The most recent deformation appears to be due to mining.—E.S.L.

2468 **Gretener, P. E.** Reply [to discussion of 1965 paper by A. E. Scheidegger]: Jour. Geophys. Research, v. 70, no. 24, p. 6215, 1965.

In reply to Scheidegger's discussion (ibid., v. 70, no. 24, p. 6213, 1965), Gretener states that he merely showed that using an excessive value for the minor horizontal stress leads to a significant overestimation of the major horizontal stress. He also maintains that the state of stress in the invaded zone is altered in the way he described, so that a tensile stress occurs in the invaded matrix at a fluid pressure less than that required for fracture under nonpenetrating conditions; a possible exception may exist in the limiting case of full penetration, but that condition is seldom, if ever, realized in the hole.—D.B.V.

2309 **Griffin, D. L.** The Devonian Slave Point, Beaverhill Lake, and Muskwa Formations of northeastern British Columbia and adjacent areas: British Columbia Dept. Mines and Petroleum Resources Bull. 50, 90 p., illus., table, 1965.

The limestone and dolomite of the Slave Point Formation change to shale along a linear front trending north-northeast. Reef development along this front is indicated. Lithologic components are discussed, especially the white and gray dolomite. The Beaverhill Lake Formation is divided into two units and evidence is given suggesting that the lower part is a facies equivalent of the Slave Point; cross sections illustrate the relationship. The Muskwa Formation overlies an erosion surface, but is transitional with the overlying Fort Simpson Formation. A section on occurrence of natural gas in the Slave Point is included. Core descriptions and formation tops are given in appendixes.—E.S.L.

Griffitts, Wallace R. *See* Staatz, Mortimer H. 2521

Griscom, Andrew. *See* Pavlides, Louis. 2375

2284 **Gross, M. Grant.** Carbonate deposits on Plantagenet Bank near Bermuda: Geol. Soc. America Bull., v. 76, no. 11, p. 1283–1290, 1965.

Drilling on Plantagenet Bank, southwest of the Bermuda Islands, cut 20 m of carbonate sediment and dolomite without reaching the substrata. The top 13 m consisted of fragments of calcareous algae, Foraminifera, mollusks, and coral; samples from 8 and 13 m were partly consolidated and dolomitized. At 20 m the rock was all dolomite, but it contained fragments of coralline algae. The C–13 content of the carbonates is similar to that from sediments and calcareous skeletal fragments from the Bermuda Islands. However, undolomitized sediments are richer in O–18 than modern sediments from Bermuda, and the dolomite is richer in O–18 by 3 to 3.7 per mil than the undolomitized sediments. The increase in O–18 may be due to waters enriched in O–18.—S.C.C.

Grubich, Donald N. *See* Farnham, R. S. 2510

Gude, Arthur, J., 3d. *See* Sheppard, Richard A. 2668

2627 **Gupta, Ravindra N.; McTaggart-Cowan, Gillian H.** Crustal seismic refraction profiles, a compilation (Supplement no. 1)—Contract No. AF 19(628) 222, Sci. Rept. 9: Toronto, Ontario, Univ. Toronto Inst. Earth Sci., 13 p., illus., table, 1964.

In this supplement to "The crustal seismic refraction profiles, a compilation" by R. K. McConnell, Jr. and McTaggart Cowan (1963), additional information available since that report has been summarized; errata to the original compilation is attached. The work was supported by the U.S. Air Force Cambridge Research Laboratory through VELA UNIFORM project.—M.C.M.

2256 **Gwinn, V. E.** Cretaceous rocks of the Clark Fork Valley, central western Montana, *in* Geology of the Flint Creek Range, Montana—Billings Geol. Soc., 16th Ann. Field Conf. 1965: Billings, Mont., Billings Geol. Soc., p. 34–57, illus., 1965.

In Clark Fork Valley, Montana, the basal Cretaceous Kootenai Formation contains four widespread lithologic units, including two intervals of lacustrine limestone. The Colorado Group is approximately seven times thicker in this area than it is east of the Boulder batholith, and contains a much greater proportion of sandstone; significant facies changes occur at several stratigraphic levels. No bentonite was observed in volcanic-rich intervals of the Clark Fork Cretaceous. Final withdrawal of the seas occurred during middle Late Cretaceous time, and the Golden Spike Formation, uppermost unit west of the batholith, is a sequence of intertongued volcanic rocks and nonvolcanic conglomerate.—E.S.L.

Hackett, P. *See* Addinall, E. 2657

Hagar, David Jon. *See* Borns, Harold William, Jr. 2185

2201 **Hagni, Richard D.; Såadallah, Adnan A.** Alteration of host rock limestone adjacent to zinc-lead ore deposits in the Tri-State district, Missouri, Kansas, Oklahoma: Econ. Geology, v. 60, no. 8, p. 1607–1619, illus., 1965.

Distally from ore bodies of the Tri-State district the M-bed limestone consists predominantly of allochems, mainly crinoids; microcrystalline calcite, sparry calcite, and microspar are subordinate constituents. Starting at 40–80 feet from the ore bodies, the allochem content progressively decreases, and sparry calcite increases. Other components show little change.—W.S.W.

2682 **Hahl, D. C.; Wilson, M. T.; Langford, R. H.** Physical and chemical hydrology of Great Salt Lake, Utah, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-C, p. C181–C186, illus., tables, 1965.

The changes in stage and salinity of the Great Salt Lake since records began in 1851 are reviewed. The results of a mineral-inflow study made during the water years 1960–61 are described, and the chemical character of the lake brine and some results of the current study of mineral transport within the lake are discussed. W.L.G.

2297 **Haigler, Leon B.; Sutherland, Helen L.** Reported occurrences of selected minerals in New Mexico (includes most metals and nonmetals; does not include mineral fuels, sodium and potassium salts, phosphate, or sulfur): U.S. Geol. Survey Mineral Inv. Resource Map MR-45, 2 sheets, scale 1:500,000, 1965.

Halbig, Joseph B. *See* Wright, Harold D. 2673

2496 **Halbouty, Michel T.** Economics—The new dimension in geological thinking [abs.]: Houston Geol. Soc. Bull., v. 8, no. 4, p. 19, 1965.

Hall, Frank. *See* Illich, Harold. 2259

Hall, M. L. *See* Ehinger, R. F. 2549

Hamilton, Donald. *See* Bennett, Allan. 2426

Hamlin, Howard P. *See* Drake, Avery Ala, Jr. 2573

2230 **Hannon, Willard James, Jr.** Some effects of a layered system on dilatational waves [abs.]: Dissert. Abs., v. 25, no. 11, p. 6693, 1965.

2147 **Hansen, Alan R.** Reef trends of Mississippian Ratcliffe zone, northeastern Montana and northwestern North Dakota [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1571, 1965.

2489 **Hardy, Ronald G.; Bauleke, Maynard P.; Hornbaker, Allison L.; Hess, William R.; Hladik, William B.** Kansas industrial mineral development—A feasibility study for the production of filter aids from Kansas volcanic ash: Kansas Geol. Survey Spec. Distrib. Pub. 19, 34 p., illus., tables, 1965.

Kansas volcanic ash, a white to light pearly gray material, presumably came from volcanoes located near the Rocky Mountains west or southwest of the State, was thrown into the air by explosive volcanic eruptions, and carried to Kansas by winds. Ash falls are of limited areal extent and range in thickness from a few inches to more than 30 feet. From 1920 to 1945 the ash was used primarily as an abrasive material, but with the use of other products, production of the ash has declined. Most of this study is devoted to use of the ash as a filter aid.—M.C.M.

2335 **Harland, W. B.** Discussion [of continental reconstructions], *in* A symposium on continental drift: Royal Soc. London Philos. Trans., ser. A, v. 258, no. 1088, p. 59–75, illus., 1965.

The tectonic evolution of the Arctic–North Atlantic region is discussed, mainly on the basis of study of the relationships of Greenland and Spitsbergen. A special theory of continental drift, for a limited area, is proposed, which is consistent with available stratigraphic, structural, paleomagnetic, and geophysical evidence. The sequence of events is outlined. Some general considerations that follow from this regional analysis are discussed.—D.B.V.

2612 **Harlton, Bruce H.** Surface and subsurface subdivisions of Cambro–Ordovician carbonates of Oklahoma, *in* Symposium on the Arbuckle: Tulsa Geol. Soc. Digest, v. 32, p. 38–42, illus., 1964.

This paper is concerned principally with subdivision of the massive carbonate succession of the Arbuckle Group of Lower Ordovician age. The Chapman Ranch, formerly the basal member of the McKenzie Hill Formation, is here elevated to formational status. The formations of the underlying Timbered Hills Group, Cambrian, are also described and the insoluble residues compared with the Arbuckle Group. On the basis of insoluble residues, the Kindblade and West Spring Creek Formations constitute one lithologic unit. A correlation chart is included.—E.S.L.

2173 **Harper, Melvin Louis.** Mechanics of basement deformation in Glenwood Canyon, Colorado [abs.]: Dissert. Abs., v. 25, no. 10, p. 5860–5861, 1965.

2142 **Harris, L. A.; Finch, C. B.** Crystallographic data for Er_2SiO_5 and Y_2SiO_5: Am. Mineralogist, v. 50, no. 9, p. 1493–1498, tables, 1965.

X-ray powder diffraction and single crystal data are given for synthetic Er_2SiO_5 and Y_2SiO_5.—M.L.L.

2529 **Harris, Leonard D.** Geologic map of the Tazewell quadrangle, Claiborne County, Tennessee: U.S. Geol. Survey Geol. Quad. Map GQ-465, scale 1:24,000, section, text, 1965.

Limestone and dolomite suitable for crushed stone are quarried mostly from the Hurricane Bridge Limestone. Prospecting for zinc ore in the Knox Group in and near Straight Creek has resulted in some mining as late as 1946. Limonite accumulations along the outcrop area of the Copper Ridge Dolomite in the drainage area of Straight Creek are probably related to the oxidation of pyrite which accompanies sphalerite in the mineralized areas.—M.C.M.

Harris, W. L. *See* Ehinger, R. F. 2549

2243 **Harrison, Jack L.; Murray, Haydn H.** Clays and shales of Indiana: Indiana Geol. Survey Bull. 31, 40 p., illus., tables, 1964.

Modern concepts of clays as assemblages of discrete minerals form the basis for the first revaluation of the clays and shales of Indiana since 1933. Brief explanations of the fundamentals of clay mineralogy and the major methods of clay investigation are given. Tabulated mineralogic, ceramic, and chemical data for 251 of 1,000 samples show that Indiana has large reserves suitable for many types of products.—E.S.L.

2215 **Hashad, Ahmad Hassanain.** Geochronological studies in the central Wasatch Mountains, Utah [abs.]: Dissert. Abs., v. 25, no. 11, p. 6533–6534, 1965.

2569 **Hass, Wilbert H.; Huddle, John W.** Late Devonian and Early Mississippian age of the Woodford Shale in Oklahoma, as determined from conodonts, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525–D, p. D125–D132, illus., table, 1965.

Conodont collections from eight measured sections in Carter, Murray, Pontotoc, and Pittsburg Counties show that most of the Woodford Shale is Late Devonian in age, but that the uppermost part is Early Mississippian (Kinderhook). The Mississippian (Kinderhook) part of the Woodford Shale is generally less than 1 foot thick, but on Henryhouse Creek near Woodford, it is at least 10 feet thick. The oldest conodont fauna found in the base of the Woodford Shale is early Late Devonian in age.—Authors' abstract

Hawkins, R. H. *See* Horton, J. H. 2240

Healey, D. L. *See* Anderson, R. E. 2571

2538 **Heard, H. C.; Turner, F. J.; Weiss, L. E.** Studies of heterogeneous strain in experimentally deformed calcite, marble, and phyllite: California Univ. Pubs. Geol. Sci., v. 46, no. 3, p. 81–152, illus., 1965.

Initial yielding in experimentally deformed crystalline material is heterogeneous, forming local structures such as kinks and deformation bands similar to those in some naturally deformed rocks. The analogy is most clear between single crystals with one prominent glide system and markedly foliated rocks. The deformation mechanism was tested on single calcite crystals at 5 kb, 25° 500°C, and at strain rates both faster and slower than usual. Grains of calcite in and near tongues of material that extruded through a terminal cylindrical orifice developed preferred orientation of *c* and *a* axes.—W.P.I.

Heck, W. J. *See* Lane, K. S. 2645

2291 **Hedges, James.** A vertical shaft beneath cherty caprock at Dutton's Cave, Iowa [abs.], *in* Internat. Cong. Speleology, 4th, Yugoslavia, 1965, Summ. Lectures: Ljubljana, Yugoslavia, Speleol. Soc. Yugoslavia, p. 33, 1965.

2447 **Heindl, L. A.; Fair, C. L.** Mesozoic(?) rocks in the Baboquivari Mountains, Papago Indian Reservation, Arizona: U.S. Geol. Survey Bull. 1194–I, p. I1–I12, illus., 1965.

This report defines and describes briefly rocks of probable Mesozoic age in the west-central part of the Baboquivari Mountains, including one metamorphic unit and three formations of sedimentary and volcanic materials of rhyolitic to andesitic composition. The section is about 20,000 feet thick. The Mesozoic(?) age is given largely on the basis of the similarity of some units to Mesozoic rocks nearby, their dissimilarity to Paleozoic rocks, and their angular unconformity with overlying Tertiary deposits.—W.L.G.

2610 **Heindl, L. A.** Mesozoic formations in the Comobabi and Roskruge Mountains, Papago Indian Reservation, Arizona: U.S. Geol. Survey Bull. 1194–H, p. H1–H15, illus., 1965.

A composite Mesozoic section in the Comobabi and Roskruge Mountains of south-central Arizona is defined and described. The section comprises six new formations which consist of andesitic to rhyolitic volcanic rocks and of sedimentary deposits

largely derived from them. A composite section is between 20,000 and 35,000 feet thick. Dinosaur fragments in the Cocoraque Formation are of late Mesozoic age, and the upper part of the Roskruge Formation is Late Cretaceous. The lowest unit is considered to be Mesozoic because it is so unlike Precambrian or Paleozoic strata in this region. More precise dating of all formations is necessary before restriction of the section to Cretaceous can be assumed.—W.L.G.

2632 **Heinrich, E. William.** Composite aplite–pegmatites of the Franklin–Sylva district, North Carolina: Am. Mineralogist, v. 50, no. 10, p. 1681–1697, illus., tables, 1965.

The Franklin–Sylva district of southern North Carolina contains a number of multiphase, composite, aplite–pegmatite intrusions of tonalitic–granodioritic composition. In several examples it can be demonstrated that the periods of crystallization of the aplite and pegmatite overlapped. The general age sequence of intrusion has been: (1) batholiths of Whiteside tonalite–granodiorite, (2) dikes of aplitic tonalite–granodiorite, (3) dikes of granodioritic–tonalitic pegmatite and (4) dikes of aplitic tonalite granodiorite. In this district the periods of generation and expulsion of aplitic and pegmatitic fractions overlapped, and the finer and coarser phases of the composite intrusions are not the result of differing intramural conditions during crystallization.—Author's abstract

2637 **Henderson, J. F.** (compiler). Survey of current geological research in Canada: Canada Natl. Advisory Comm. Research Geol. Sci., 15th Ann. Rept. 1964–65, 207 p., 1965.

This bibliography records research in progress in universities, federal and provincial departments of mines, and other nonindustrial institutions for the period June 1964–May 1965. Projects are grouped under different branches of geological sciences and an author index is included.—E.S.L.

2458 **Henderson, Roland G.** Memorial to Henry R. Joesting (1903–1965): Geol. Soc. America Bull., v. 76, no. 10, p. P157–P162, portrait, 1965.

2381 **Hendricks, Leo.** Stratigraphic summary of the Ellenburger Group of north Texas, *in* Symposium on the Arbuckle: Tulsa Geol. Soc. Digest, v. 32, p. 119–125, illus., 1964.

The Ellenburger is a blanket of carbonate beds in the subsurface of northern Texas that is coextensive with a part of the Arbuckle Group of the midcontinent. It represents a thinner, less complete accumulation of sediments of Early Ordovician age than in southern Oklahoma. The Ellenburger, as now defined, includes the Wilberns, Tanyard, Gorman, and Honeycut Formations, and post–Honeycut beds. These are described and fence diagrams show their distribution.—E.S.L.

2557 **Hendricks, T. A.** Resources of oil, gas, and natural–gas liquids in the United States and the world: U.S. Geol. Survey Circ. 522, 20 p., illus., tables, 1965.

An estimate of the quantities of oil, gas, and natural–gas liquids originally in place in the United States is made on the basis of data on exploratory footage drilled, fraction of total volume of sedimentary rocks explored, past production records, estimates of proved reserves, and attractiveness of explored rocks versus rocks yet unexplored. Productive areas of the United States are then divided into four categories according to relative productivity, and a factor of quantity in place per thousand square miles is derived for each commodity in each category. Finally, world sedimentary areas are divided into similar categories and the measured area of each category multiplied by the appropriate factor. Resulting quantities for regional or continentwide areas are added together. About five–eighths of oil and gas resources in the United States may be discovered to date.—V.S.N.

2358 **Herndon, Tom.** The Frederick field, Tillman County, Oklahoma (also called Southeast Frederick), *in* Symposium on the Arbuckle: Tulsa Geol. Soc. Digest, v. 32, p. 142–143, illus., 1964.

The paper consists of a structure contour map and a brief description of the field.—E.S.L.

2359 **Herndon, Tom.** The West Frederick field, Tillman County, Oklahoma, *in* Symposium on the Arbuckle: Tulsa Geol. Soc. Digest, v. 32, p. 144–145, illus., 1964.

The paper consists of a structure contour map and a brief description of the field.—E.S.L.

2504 **Hersey, J. B.** Sediment ponding in the deep sea: Geol. Soc. America Bull., v. 76, no. 11, p. 1251–1260, illus., 1965.

Echo soundings over the North Atlantic Ocean and the Mediterranean Sea have revealed horizontal layers of sediment that extend continuously across nearly flat floors of enclosed basins. It is suggested that all deep-sea enclosed basins (also in some shallower basins such as those off the coast of California) will be found to contain such layering in contrast to other abyssal plain areas. Flysch and similar sedimentary rocks may have formed originally in ancient enclosed basins.—V.S.N.

Hershey, Robert E. *See* Luther, Edward T. 2351

Hertz, P. B. *See* Schwerdtner, W. M. 2451

Hess, William R. *See* Hardy, Ronald G. 2489

2491 **Heylmun, E. B.** Plain facts about oil and gas in Utah: Utah Geol. and Mineralog. Survey Circ. 46, 14 p., illus., 1965.

At least two-thirds of Utah may be considered potentially favorable oil and gas land, and nearly one-half of the State is situated in known oil and gas provinces; the main oil and gas areas are the Uinta basin in the northeast and the Paradox basin in the southeast. Except for the Uncompahgre uplift, all oil produced in the southeastern part is from marine Paleozoic rocks; Mesozoic rocks produce gas and some oil in various localities; and in the Uinta basin, most oil and gas is contained in Tertiary lake deposits. A table shows average depth to top of principal producing zones at selected oil and gas fields. The shallowest production is from Tertiary rocks about 150 feet deep at Rozel Point and the deepest production from Mississippian and Devonian rocks at a depth of about 9,300 feet in Lisbon field.—M.C.M.

2174 **Hillhouse, Douglas Neil.** Geology of the Piney River–Roseland titanium area, Nelson and Amherst Counties, Virginia [abs.]: Dissert. Abs., v. 25, no. 10, p. 5861, 1965.

Hills, D. L. *See* Pettyjohn, W. A. 2484

Hladik, William B. *See* Hardy, Ronald G. 2489

Hlavin, William. *See* Scheele, William E. 2283

Hogberg, Rudolph. *See* Tufford, Sarah. 2479

Holbrook, Charles E. *See* Alvord, Donald C. 2317

2560 **Holmes, Ralph J.** Paul Francis Kerr: Am. Mineralogist, v. 50, no. 10, p. 1519–1531, 1965.

2393 **Holt, C. L. R., Jr.** Geology and water resources of Portage County, Wisconsin: U.S. Geol. Survey Water-Supply Paper 1796, 77 p., illus., tables, 1965.

The hydrology and geology of Portage County are described in this report with emphasis on ground water and its relation to surface water. The water gains and losses are given in a hydrologic budget. Ground water of generally good quality adequate for municipal, industrial, and irrigation needs is available from the extensive sand and gravel deposits; the principal source is the thick cover of glacial drift. Water-management problems are discussed and suggestions are given for their solution.—W.L.G.

2635 **Hooker, Marjorie.** Bibliography of Paul Francis Kerr: Am. Mineralogist, v. 50, no. 10, p. 1532–1545, 1965.

Hornbaker, Allison L. *See* Hardy, Ronald G. 2489

Hornsey, Edward E. *See* Panek, Louis A. 2653

2240 **Horton, J. H.; Hawkins, R. H.** Flow path of rain from soil surface to water table: Soil Sci., v. 100, no. 6, p. 377–383, illus., 1965.

The percolation of rainwater through the soil to the water table is accomplished throughout most of the flow path by downward displacement of water previously retained by the soil at field capacity. The rate at which water can flow through a column of spheres is found to be the product of the capillary conductivity and potential gradient.—J.W.H.

2216 **Horvath, Allan Leo.** Stratigraphy of the Silurian rocks of southern Ohio and adjacent parts of West Virginia, Kentucky, and Indiana [abs.]: Dissert. Abs., v. 25, no. 11, p. 6535, 1965.

Hosterman, John W. *See* Knechtel, Maxwell M. 2572

2404 **Houston Geological Society.** Homer A. Noble (1893–1965): Houston Geol. Soc. Bull., v. 8, no. 4, p. 17–18, portrait, 1965.

2664 **Houston, Robert S.; Murphy, John F.** Age and distribution of sedimentary zircon as a guide to provenance, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525–D, p. D22–D26, illus., tables, 1965.

Two distinct varieties of zircon were handpicked from Upper Cretaceous black sandstone deposits in Wyoming and dated by the lead-alpha method as 80±15 and 770±80 m.y. Based on the principle that an unmetamorphosed sedimentary rock can be no older than the youngest zircon it contains, the younger zircon provides a limiting age of 95 m.y. for the base of the Upper Cretaceous Frontier Formation. The older zircon is a well-rounded, apparently much reworked variety of Precambrian age. The regional distribution of the zircon and the age of the younger zircon suggest a source to the northwest, presumably the Idaho batholith or related extrusive rocks.—Authors' abstract

2431 **Howard, Hildegarde.** First record of avian fossils from the Eocene of California: Jour. Paleontology, v. 39, no. 3, p. 350–354, illus., 1965.

The recovery of two avian bones from the Eocene of San Diego, California marks the first recording of bird life in California prior to the Miocene. A new species *Protostrix californiensis* (Order Strigiformes) is described, and the Order Gruiformes tentatively recorded.—Author's abstract

2530 **Huber, N. King; Rinehart, C. Dean.** Geologic map of the Devils Postpile quadrangle, Sierra Nevada, California: U.S. Geol. Survey Geol. Quad. Map GQ–437, scale 1:62,500, section, 1965.

Huddle, John W. *See* Hass, Wilbert H. 2569

2524 **Hurlbut, C. S., Jr.** Detailed description of sarcopside from East Alstead, New Hampshire: Am. Mineralogist, v. 50, no. 10, p. 1698–1707, illus., tables, 1965.

Graftonite and sarcopside are intergrown in tabular alternating layers and also in fibrous columns. Thin section studies show vivianite also to be present in the East Alstead and Deering intergrowths. Exsolution of graftonite and sarcopside from a parent phase results in an enrichment of iron and calcium in graftonite and of manganese in sarcopside.—M.L.L.

2502 **Huxel, C. J., Jr.; Petri, L. R.** Geology and ground water resources of Stutsman County, North Dakota—Pt. 3, Ground water and its chemical quality: North

Dakota Geol. Survey Bull. 41, pt. 3 (North Dakota Water Conserv. Comm. County Ground Water Study 2, pt. 3), 58 p., illus., tables, 1965.

Most of the ground water is developed from Cretaceous formations, Dakota Sandstone and Pierre Shale, and overlying Pleistocene glacial drift. Permeable deposits of the drift furnish the most readily available and largest supplies of ground water and small quantities of ground water are available from the bedrock formations. Most wells in the county are used to supply water for domestic or stock-watering needs. Most of the ground water is of relatively poor quality for domestic, municipal, or industrial uses. However, water from surficial sand and gravel deposits can be treated to make it acceptable for general use.—*from* Authors' abstract

Illich, H. A. *See* Ehinger, R. F. 2549

2259 **Illich, Harold; Hall, Frank.** The Cambrian-Belt Supergroup contact in western Montana, *in* Geology of the Flint Creek Range, Montana—Billings Geol. Soc., 16th Ann. Field Conf. 1965: Billings, Mont., Billings Geol. Soc., p. 89-97, illus., 1965.

The existence of a regional unconformity between the Precambrian Belt Supergroup and the Cambrian has been demonstrated in central and eastern Montana, but as yet its presence cannot be demonstrated in the western part of the state. It may exist but is obscured by the lithology of the bounding units. No evidence has been found that Cambrian units immediately overlie different units of the Belt Supergroup. Two cross sections are included.—E.S.C.

2450 **Irvine, T. N.** Chromian spinel as a petrogenetic indicator—Pt. 1, Theory: Canadian Jour. Earth Sci., v. 2, no. 6, p. 648-672, illus., tables, 1965.

In this paper, theoretical expressions are derived whereby the prism graphically portraying the chromium-bearing spinel solid solutions may be 'contoured' for conditions of isothermal-isobaric equilibrium. The phase relations and thermodynamic characteristics of the spinel system are discussed, and theoretical considerations of spinel paragenesis form the major part of the paper.—E.S.L.

Irwin, William P. *See* Lanphere, Marvin A. 2665

Jackson, G. D. *See* Donaldson, J. A. 2449

2565 **Jackson, W. H.; Pakiser, L. C.** Seismic study of crustal structure in the southern Rocky Mountains, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-D, p. D85-D92, illus., tables, 1965.

Two underground mining blasts, detonated at Climax, Colo., on May 21 and 23, 1964, were recorded at 17 locations in the Front Range uplift of the Southern Rocky Mountains at 25 to 360 km north of the shotpoint. Strong secondary events recorded at distances ranging from 119 to 192 km from the shotpoint were identified as reflections from the M-discontinuity and from an intermediate layer in the crust. An analysis of both reflected and refracted events suggests that the crustal thickness north of Climax is approximately 54 km and that it decreases abruptly by about 15 km in the area directly east of the Uinta Mountains. Comparison of crustal models in the different geologic and physiographic provinces of the Far West indicates that isostatic compensation is related primarily to density variations in the upper mantle and only secondarily to variations in crustal thickness.—*from* Authors' abstract

2410 **James, Alfred, 3d.** A study of the Aldrich and Arnold oil producing trends of northwestern Ness County, Kansas [abs.]: Tulsa Geol. Soc. Digest, v. 32, p. 168, 1964.

2395 **James, W. H., Jr.** Jack Eley (1918-1964): Tulsa Geol. Soc. Digest, v. 32, p. 24, portrait, 1964.

2430 **Jeletzky, J. A.; Clemens, William A.** Comments on Cretaceous Eutheria, Lance *Scaphites*, and *Inoceramus?* ex Gr. *tegulatus*: Jour. Paleontology, v. 39, no. 5, p. 952–959, 1965.

This is an addendum to Jeletzky's (1962) study of Danian dinosaur bearing rocks and the Mesozoic-Cenozoic boundary. All adequately sampled North American Late Cretaceous mammalian local faunas are made up of multituberculates, placentals, and marsupials. An increase in the relative abundance of placentals occurred at least locally before the extinction of the dinosaurs. The records of *Scaphites* and other marine organisms in the upper part of the Lance Formation are probably the result of erratic introduction of contemporaneous animals during deposition.—F.C.W.

Jenkins, Lillie B. *See* May, Irving. 2638

2469 **Jensen, M. L.** The rational and geological aspects of solid diffusion: Canadian Mineralogist, v. 8, pt. 3, p. 271–290, illus., 1965.

Theoretical calculations of the activation energies for direct interchange, interstitial and vacancy diffusion in f.c.c. copper compared to the empirical activation energy determined from self diffusion indicate the importance of the vacancy mechanism, a conclusion supported by calculated and experimental activation energies of diffusion in sodium chloride. Activation energies for diffusion of solutes in complex silicate minerals have been determined only in a few instances. Vapor pressure increases diffusion rates in ionic bonded minerals, e.g. at 400°C and about 300 bars the diffusion rate of Na^{22} in Yule marble is about 10^6 times the rate of 400°C and 1 bar. The distances over which true solid diffusion can be significant are apparently relatively short.—E.Z.

Jewell, John W. *See* Swingle, George D. 2336

Jewell, John W. *See* Tiedemann, Herbert A. 2346

2352 **Jewell, John W.** Coal map of the Sewanee seam, Cardiff quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 123-NW [sheet 2], scale 1:24,000, 1965.

This map accompanies the geologic map by H. A. Tiedemann (et al) and the mineral resources summary by G. D. Swingle and J. W. Jewell, both cited separately. M.C.M.

2399 **Johnson, Edward L.** Glenn Rodgers Vickery Griffith (1891–1964): Tulsa Geol. Soc. Digest, v. 32, p. 28, portrait, 1964.

Johnson, Nyra A. *See* Price, Don. 2523

2619 **Jones, David L.; Murphy, Michael A.; Packard, Earl L.** The Lower Cretaceous (Albian) ammonite genera *Leconteites* and *Brewericeras*: U.S. Geol. Survey Prof. Paper 503-F, p. F1–F21, illus., tables, 1965.

Lower Cretaceous (Albian) ammonites from the Pacific coast of North America designated as *Leconteites lecontei, L. modestum* (in part), *Puzosigella mulleri, P. taffi, P. rogersi*, and *P. perrinsmithi* (in part) are regarded as forming one variable but intergrading species to which the name *L. lecontei* (Anderson) is applied. *Puzosigella sacramentica* (Anderson) is regarded as a separate species of *Leconteites*, and the name *Puzosigella* is rejected. A new subspecies, *L. lecontei whiteavesi*, is recognized from Albian beds of Queen Charlotte Islands. Genus *Brewericeras* is regarded as a direct descendant of *Leconteites* and contains two species: *B. breweri* (Gabb) and *B. hulenense* (Anderson).—*from* Authors' abstract

2175 **Jones, Robert Alan.** Geology and petrography of Ordovician volcanic rocks, Bathurst-Newcastle District, New Brunswick [abs.]: Dissert. Abs., v. 25, no. 10, p. 5861–5862, 1965.

2413 **Jordan, Louise.** The geology and economic future of the salt deposits of Oklahoma [abs.]: Tulsa Geol. Soc. Digest, v. 32, p. 170–171, 1964.

2217 **Jordan, William Malcolm.** Regional environmental study of the early Mesozoic Nugget and Navajo Sandstones [abs.]: Dissert. Abs., v. 25, no. 11, p. 6535–6536, 1965.

Jussen, Virginia M. *See* King, Ruth Reece, 2444

Kane, Martin F. *See* Pavlides, Louis, 2375

2150 **Kapp, Ronald O.** Illinoian and Sangamon vegetation in southwestern Kansas and adjacent Oklahoma: Michigan Univ. Mus. Paleontology Contr., v. 19, no. 14, p. 167–255, illus., tables, 1965.

The vegetation associated with certain Illinoian glacial and Sangamon interglacial fossil fauna from the southern High Plains is discussed. The study permits evaluation and extension of the previous paleoecologic and climatic interpretations of the Illinoian and Sangamon ages. Results of pollen analysis of samples from six fossil localities in the two States are presented in tabular form and pollen diagrams. Three deposits, essentially contemporaneous, are believed to date from the maximum Illinoian glaciation; variations in frequency of pine, spruce, and fir indicate the changes in climate. The record of Sangamon times is less satisfactory, but conifers were replaced by open grasslands, and lizard fauna in early Sangamon time is evidence of dry uplands.—G.D.C.

2184 **Kauffman, Erle G.; McCulloch, David S.** Biota of a late glacial Rocky Mountain pond: Geol. Soc. America Bull., v. 76, no. 11, p. 1203–1232, illus., 1965.

The sediments of a sag pond in the Huerfano Park area, south central Colorado, have yielded wood with radiocarbon age of 9,600±200 yr and a varied biota consisting of vertebrate remains (prairie dog, frog, salamander, snake, fish), terrestrial and fresh-water mollusks (mainly gastropods), sponges, pollen, and diatoms. Paleoclimatic considerations, based on lithologic and biotic criteria, indicate alternating wet and dry periods in an early stage, a warm dry period with relatively mild winters in a middle stage, and finally a climate slightly cooler and wetter than exists in the area today during which the lake was reduced to a marsh as vegetation persistently encroached upon the lake.—H.C.W.

2550 **Kauffman, M. E.** Cambrian stratigraphy in the Drummond–Garnet Range area, *in* Geology of the Flint Creek Range, Montana—Billings Geol. Soc., 16th Ann. Field Conf. 1965: Billings, Mont., Billings Geol. Soc., p. 79–88, illus., tables, 1965.

About 2,000 feet of Cambrian rocks are present in the Drummond–Garnet Range area and include the Flathead, Silver Hill, Hasmark, and Red Lion Formations. A brief description of each formation is given, and correlation within the State is discussed. Two cross sections are included and a chart shows the development of nomenclature. Fossils are listed in a table.—E.S.L.

2519 **Kaye, Clifford A.** Folding of the Nahant gabbro, Massachusetts, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-C, p. C12–C19, illus., geol. map, 1965.

The medium-grained gabbro along the Nahant shore has been broken by closely spaced parallel partings and deformed into a series of anticlines and synclines. From a moderate distance, these rocks resemble a folded sedimentary rock. Slickensided bedding planes, the form and distribution of partings, and similar geometry of folds indicate that the folds formed as multilayered flexures and the partings as a consequence of the flexures. The detailed manner of formation is discussed and illustrated.—W.L.G.

2667 **Kaye, Clifford A.; Mrose, Mary E.** Magnetic spherules, colored corundum, and other unusual constituents of a heavy beach sand, Martha's Vineyard, Massachusetts, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-D, p. D37–D43, illus., tables, 1965.

Naturally concentrated heavy beach sand from western Martha's Vineyard contains small quantities of magnetic spherules, red and blue corundum, gahnite, native

copper, and gold. Except for larger average size, the magnetic spherules are similar to those considered to be of extraterrestrial origin. Their composition is maghemite and magnetite. Surfaces and shapes are varied and reflect crystalline structure. Colored corundum, gahnite, and native copper are known to occur in the rocks of western Massachusetts and Connecticut and the grains may have been transported by glacial ice from there to the southeastern part of Massachusetts.—Authors' abstract

2463 **Keen, M. J.; Tsong, C. F.; Blanchard, J. E.** The propagation of the compressional wave in the crust [Pt.] 1, A simple treatment of the data: Canadian Jour. Earth Sci., v. 2, no. 6, p. 543–559, illus., tables, 1965.

Seismic experiments have been undertaken along the Atlantic coast of Nova Scotia. In this part of the paper the change in amplitude of the first half cycle of the first event is investigated, and compared with the change in amplitude which might be expected if propagation occurred as a "head wave", and if propagation occurred because of the presence of a velocity gradient in the upper few kilometers of the Earth's crust. It was not possible to distinguish between the two mechanisms with any certainty, and, although the suggestion is made that the value of Q is in the range 90 to 300 depending upon the propagation mechanism, the assumptions which underlie the approach are criticized, and a more reasonable one put forward.—*from* Authors' abstract

2464 **Keen, M. J.; Tsong, C. F.** The propagation of the compressional wave in the crust [Pt.] 2, Synthetic seismograms: Canadian Jour. Earth Sci., v. 2, no. 6, p. 560–576, illus., tables, 1965.

Synthetic seismograms have been generated in an attempt to measure the attenuation of compressional waves beneath the Atlantic coast of Nova Scotia; the results suggest that the value of Q must be of the order of 300, whatever the mechanism of propagation may be. Comparison with results of experiments in the Gulf of St. Lawrence shows that attenuation of first events in the range of distance up to 60 km is more rapid in the rocks beneath the Gulf than in those beneath the Atlantic coast of Nova Scotia. This may be due either to attenuation in the upper sedimentary layers, present in the one place but not in the other, or to greater attenuation within rocks in which the compressional wave velocity is the same as in those beneath the Atlantic coast.—Authors' abstract

Keller, W. D. *See* Reesman, A. L. 2448

2360 **Kennedy, L. E.; Peters, L. B., Jr.** South Canyon Creek field, Osage County, Oklahoma, *in* Symposium on the Arbuckle: Tulsa Geol. Soc. Digest, v. 32, p. 146–147, illus., 1964.

The paper consists of a structure contour map and a brief description of the field.—E.S.L.

2361 **Kennedy, L. E.; Peters, L. B., Jr.** Country Club field, Osage County, Oklahoma, *in* Symposium on the Arbuckle: Tulsa Geol. Soc. Digest, v. 32, p. 148–149, illus., 1964.

The paper consists of a structure contour map and a brief description of the field.—E.S.L.

2362 **Kennedy, L. E.; Peters, L. B., Jr.** Whitecliff Dome field, Osage County, Oklahoma, *in* Symposium on the Arbuckle: Tulsa Geol. Soc. Digest, v. 32, p. 150–151, illus., 1964.

The paper consists of a structure contour map and a brief description of the field.—E.S.L.

2401 **Kidwell, A. L.** Robert William Biggart (1908–1964): Tulsa Geol. Soc. Digest, v. 32, p. 30, portrait, 1964.

2176 **Kimyai, Abbas.** Palynology of the Raritan Formation (Cretaceous) in New Jersey and Long Island [abs.]: Dissert. Abs., v. 25, no. 10, p. 5862–5863, 1965.

King, E. G. *See* Pankratz, L. B. 2231

2444 **King, Ruth Reece; Loud, Elisabeth S.; Mead, Mildred Challman; Jussen, Virginia M.; Conant, Georgianna D.** Bibliography of North American geology, 1950–1959: Pt. 1, Bibliography; Pt. 2, Index: U.S. Geol. Survey Bull. 1195, Pt. 1, v. 1, p. 1–1012; v. 2, p. 1013–1790; Pt. 2, v. 3, p. 1791–2796; v. 4, p. 2797–4025, 1965.

King, W. E. *See* Sanderson, G. A. 2340

2507 **Kirkland, Douglas W.; Bradbury, John P.; Dean, Walter E., Jr.** Origin of Carmen Island salt deposit, Baja California, Mexico: Coastal Research Notes, no. 10, p. 9, 1965.

Carmen Island, in the Gulf of California about 12 mi east of Loreto, is composed of Tertiary Comondú volcanics. A north trending graben in the northern part was flooded by the Gulf in Recent time. A coral reef formed, fringing, and eventually closing the mouth of the bay, making a lagoon in which evaporites were deposited. A clastic bar formed on the seaward side of the reef and the coral died. In the southern part of the salina, salt is now produced by evaporating ground water pumped from wells which penetrate massive halite.—E.S.I.

Klein, Cornelis. *See* Frondel, Clifford, 2676

2572 **Knechtel, Maxwell M.; Hosterman, John W.** Outlook for resumption of diatomite mining in southern Maryland and eastern Virginia, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525–D, p. D151–D155, illus., 1965.

Small amounts of diatomite were mined intermittently for several decades prior to 1930 from strata of middle Miocene age in southern Maryland and eastern Virginia. As compared with California diatomite, which satisfies most of the national demand for this product, the Maryland–Virginia material contains a larger proportion of substances other than opaline silica. As these "impurities" consist chiefly of highly montmorillonitic adsorbent clay, the diatomite in which they occur may prove usable for many of the purposes for which fuller's earth and activated bentonite are now marketed.—Authors' abstract

2177 **Kneller, William Arthur.** A geological and economic study of gravel deposits of Washtenaw County and vicinity, Michigan [abs.]: Dissert. Abs., v. 25, no. 10, p. 5863, 1965.

2537 **Knopoff, Leon.** (chairman) United States program for the International Upper Mantle Project—Progress Report, 1965: Washington, D. C., Natl. Acad. Sci.—Natl. Research Council, 138 p., illus., 1965.

Summary reports are presented for studies being carried out in the United States under the Upper Mantle Project primarily by Federal agencies. The summaries, for the most part by the investigators themselves, are grouped under the following categories: seismology; heat flow; deep drilling for scientific purposes; geomagnetism; rock magnetism; gravity, geodesy, and recent movements of the Earth's crust; properties of geological materials under high pressures and temperatures; volcanological studies; nuclear geochemistry; marine geophysics; and regional investigations (Lake Superior seismic experiment; transcontinental geophysical survey and associated projects). World data centers are discussed briefly. Published reports are listed with each summary.—V.S.N.

2148 **Knowles, Raymond Robert.** Geology of the Bedford–Everett–Saxton area, Bedford County, Pennsylvania [abs.]: Dissert Abs., v. 26, no. 2, p. 985, 1965.

2647 **Knutson, C. F.; Bohor, B. F.** Microdeformation of sedimentary rocks subjected to GNOME nuclear explosion, *in* Symposium on rock mechanics, 6th, Rolla, Mo., 1964, Proc.: Rolla, Mo., Univ. Missouri, p. 152–184, illus., tables, 1964.

Microdeformation of the limestone, dolomites, and salt from the GNOME explosion occurred as microfracturing, twinning, and gliding of the interlocking crystal grains. Sandstones showed microscopic stress relief by intergranular movement, causing comminution of their detrital matrix and chemical cement. Shock pressure can be correlated with fracture and twin density in the chemical rocks and with loss of clay mineral crystallinity in the sandstone matrix. The explosion increased porosity in the chemical rocks, while it remained nearly unchanged in the sandstone. Equations can be generated that will predict the postshot rock condition if the preshot condition and maximum pressure it will receive are known.—E.S.L.

2254 **Konizeski, R. L.** Tertiary deposits in basins marginal to the Flint Creek Range, *in* Geology of the Flint Creek Range, Montana—Billings Geol. Soc., 16th Ann. Field Conf. 1965: Billings, Mont., Billings Geol. Soc., p. 10–18, illus., 1965.

Anticlinal flanks of Flint Creek Range extend to 700 feet below sea level beneath 5,500 feet of Tertiary deposits, which consist of erosional waste from the highlands plus volcanic ejecta. The Golden Spike Formation, a coarse lithified conglomerate, of conjectural age, is discussed as possibly the oldest Tertiary. All Tertiary occurrences known, either in outcrops or wells, are described. An attempt is made to interpret the geologic history in spite of the inadequacies of the early Tertiary record.—E.S.L.

2671 **Kremp, G. O. W.; Ames, H. T.** (compilers). Catalog of fossil spores and pollen—V. 23, Spores and pollen of the Upper Cretaceous and Cretaceous-Tertiary boundary: University Park, Pennsylvania State Univ. Palynol. Labs., 173 p., illus., 1965.

Republished descriptions of 140 new species or subspecies of palynomorphs are presented; descriptions of 48 proposed new genera are included on the pages assigned to type species. The republished protologs have been prepared from: Pierce, R. L., 1957, "Minnesota Cretaceous pine pollen" (one species); Pierce, 1961, "Lower Upper Cretaceous plant microfossils from Minnesota" (40 genera, 101 species); Anderson, R. Y., 1960, "Cretaceous-Tertiary palynology, eastern side of the San Juan Basin, New Mexico" (8 genera, 38 species). Included is a supplement to Volume 19 (1963) of the catalog, containing brief nomenclatural data on nine species of central European Upper Cretaceous and Tertiary palynomorphs for which new names were proposed by W. Krutsch, 1959.—V.M.J.

2611 **Krieger, Medora H.** Geology of the Prescott and Paulden quadrangles, Arizona: U.S. Geol. Survey Prof. Paper 467, 127 p., illus., tables, geol. maps, 1965.

The Prescott and Paulden 15-minute quadrangles in north-central Arizona were mapped as part of a program to determine the regional setting of the massive sulfide deposits at Jerome and Humboldt. The structure and stratigraphy of the older Precambrian, Paleozoic and Cenozoic rocks were studied and data on mineral and water resources were collected.—*from* Author's abstract

Krieger, R. A. *See* Cushman, R. V. 2145

2591 **Krinsley, Daniel B.** Birch Creek pingo, Alaska, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-C, p. C133–C136, illus., 1965.

The Birch Creek pingo is a large open-system pingo near Circle, Alaska. The top of the pingo has collapsed, forming a crater which is partly filled by a shallow pond. The stratigraphy exposed in the bluffs of the crater suggests that there was permafrost in the area during the period 6,950±400 years B.P. to 5,720±65 years B.P., which coincides with the postglacial thermal maximum. The local base level has been reduced at least five feet in the last 5,720±65 years, and the pingo has been updomed during this time.—Author's abstract

2690 **Kunkle, George R.** Computation of ground water discharge to streams during floods, or to individual reaches during base flow, by use of specific conductance, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-D, p. D207–D210, illus., 1965.

Relation between stream discharge and the chemical quality of the water as determined by specific-conductance measurements are used to analyze streamflow that consists of water from two sources. The contribution from each source is computed after measurement of the discharge and quality of the mixed streamflow water and after determination of representative quality values for each of the two kinds of water. The method is illustrated by two studies made of small streams in Iowa: (1) separation of a stream hydrograph into surface-runoff and ground-water components; and (2) verification and computation of ground-water discharge from an aquifer into a particular reach of a stream.—Author's abstract

2414 **Laing, William E.** Geology and geophysics of the Eastern Palo Duro (Hollis) Basin, southwestern Oklahoma [abs.]: Tulsa Geol. Soc. Digest, v. 32, p. 171, 1964.

2599 **Lakin, H. W.; Nakagawa, H. M.** A spectrophotometric method for the determination of traces of gold in geologic materials, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-C, p. C168-C171, tables, 1965.

Gold in a sample is dissolved with sodium bromate and hydrobromic acid and extracted from dilute hydrobromic acid with ethyl ether. The ether is evaporated, and the aqueous solution of the residue is extracted with 4,4′-bis (dimenthylamino) thiobenzophenone (TMK) in isoamyl alcohol. The absorbance of the red gold—TMK complex is proportional to the amount of gold present. As little as 20 ppb gold can be determined. Thallium interferes with the determination when present in large amounts. About 25 analyses can be made per man-day.—Authors' abstract

Lakin, H. W. *See* Nakagawa, H. M. 2600

2593 **LaMarche, Valmore C., Jr.** Distribution of Pleistocene glaciers in the White Mountains of California and Nevada, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-C, p. C144-C146, illus., 1965.

Cirques, U-shaped valleys, moraines, and till provide evidence of Pleistocene glaciation of the semiarid White Mountains. Only eastward-draining canyons were glaciated. Cirques developed on the lee side of broad summit uplands in areas where drifting snow could accumulate.—Author's abstract

2178 **Lamb, George Marion.** Biostratigraphy of the lower part of the Mancos Formation in the San Juan Basin [abs.]: Dissert. Abs., v. 25, no. 10, p. 5863-5864, 1965.

2645 **Lane, K. S.; Heck, W. J.** Triaxial testing for strength of rock joints, *in* Symposium on rock mechanics, 6th, Rolla, Mo., 1964, Proc.: Rolla, Mo., Univ. Missouri, p. 98-108, illus., 1964.

This paper is limited to laboratory tests for shear strength of the rock joint, bedding plane or fault. A key factor is that these tests do not use an intact core, but the specimen is selected (or recorded in the laboratory) to include an open joint or other defect, oriented at the inclination of the usual failure plane in the triaxial test. Early results are presented with possible applications in engineering analyses, and include an evaluation of a granite from the NORAD underground project.—E.S.L.

2601 **Laney, R. L.** A comparison of the chemical composition of rainwater and ground water in western North Carolina, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-C, p. C187-C189, illus., table, 1965.

The outstanding features of the change from rainwater to ground water in western North Carolina in terms of the chemistry of the water, are (1) an apparent lack of gradational members between typical analyses of rainwater and of ground water, (2) a change from a calcium sulfate and calcium bicarbonate composition to a mixed-cation bicarbonate composition, and (3) a marked solution of silica.—Author's conclusions

2649 **Lang, Thomas A.** Rock mechanics considerations in design and construction, *in* Symposium on rock mechanics, 6th, Rolla, Mo., 1964, Proc.: Rolla, Mo., Univ. Missouri, p. 561–605, illus., 1964.

The emphasis is on general considerations and fundamental principles rather than detailed procedures of evaluating strength properties of rocks. Basic investigations that must be considered in design of rock structures are: geologic conditions at the site, laboratory and in situ testing of rocks, rock stresses, and arrangement and orientation of the works. A procedure for elastic analysis is described. Almost half the paper is devoted to the study of deformation characteristics and strength criteria of rocks. It closes with a discussion of design concepts based on all these factors; the importance of monitoring during and after construction to check data is stressed.—E.S.L.

2207 **Langfelder, Leonard Jay.** An investigation of initial negative pore water pressure in statically compacted cohesive soil [abs.]: Dissert. Abs., v. 25, no. 11, p. 6469, 1965.

Langford, R. H. *See* Hahl, D. C. 2682

Lanphere, M. A. *See* Reiser, H. N. 2605

Lanphere, Marvin A. *See* Detterman, Robert L. 2663

2665 **Lanphere, Marvin A.; Irwin, William P.** Carboniferous isotopic age of the metamorphism of the Salmon Hornblende Schist and Abrams Mica Schist, southern Klamath Mountains, California, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-D, p. D27–D33, illus., table, 1965.

Potassium–argon ages ranging from 270±10 to 329±13 m.y. were obtained on hornblende from the Salmon Hornblende Schist and on muscovite from the Abrams Mica Schist in the southern Klamath Mountains. These ages suggest that the metamorphic event that produced the schists took place during the Carboniferous. Two younger ages obtained on the schists probably reflect the thermal effects of Nevadan plutons. Mineral ages from one of these plutons, the Shasta Bally batholith, range from 127 to 132 m.y. The isotopic data make it possible to consider certain Paleozoic strata exposed east of the metamorphic belt as protoliths of the schists. The apparent age of metamorphism . . . coincides in northern California and Oregon with a possible period of uplift during Carboniferous and with an interruption of normal marine deposition during Pennsylvanian.—Authors' abstract

2525 **Lapham, Davis M.** A new nickeliferous magnesium hydroxide from Lancaster County, Pennsylvania: Am. Mineralogist, v. 50, no. 10, p. 1708–1716, illus., tables, 1965.

The mineral has a ratio of Mg to Ni plus Fe of 4 to 1. The X-ray pattern exhibits rhombohedral symmetry and corresponds to the patterns of synthetic nickel hydroxide (II, III) and pyroaurite. The minimal cell constants (hexagonal parameters) are *a* 3.12 A and *c* 23.19 A or, less commonly 23.79 A. Based on a correspondence of X-ray reflections, unit cell size, and unit cell cation content with $Ni(OH)_2 \cdot 1/4NiOOH$, the structure is tentatively considered to be composed of 1/4(Ni,Fe)OOH embedded within the laminae of a $Mg(OH)_2$ rhombohedral lattice, the consequence of which is a *c* dimension five times that of brucite. Author's abstract

Lappi, Robert L. *See* Panek, Louis A. 2653

2452 **Larochelle, A.; Black, R. F.** The design and testing of an alternating-field demagnetizing apparatus: Canadian Jour. Earth Sci., v. 2, no. 6, p. 684–696, illus., tables, 1965.

An apparatus used at the Geological Survey of Canada for magnetic cleaning purposes is described. With this apparatus viscous components of remanent magnetization were effectively removed from a group of uniformly magnetized specimens although an appreciable scattering in magnetization directions was

observed after treatment at high peak field intensity. Tests were conducted to verify that the scattering was not inherent in the design of the apparatus.—Authors' abstract

2446 **Larrabee, David M.; Spencer, Charles W.; Swift, Donald J. P.** Bedrock geology of the Grand Lake area, Aroostook, Hancock, Penobscot, and Washington Counties, Maine: U.S. Geol. Survey Bull. 1201-E, p. E1-E38, illus., tables, geol. map, 1965.

The Grand Lake area in eastern Maine generally has low relief and contains widespread glacial drift and many lakes and swamps. It is underlain chiefly by metasedimentary rocks of Silurian and Silurian(?) age and to a lesser extent by rocks of Ordovician and possible Cambrian age. Intrusive rocks of Devonian age underlie more than a third of the area. Northeast-trending grabens in the metasedimentary and igneous rocks have preserved unmetamorphosed rocks of Late Devonian through Pennsylvanian age. A diabase dike, possibly 100 miles long, trends southwest; it is younger than the Devonian granitic intrusives.—*from* Authors' abstract

2269 **Larsen, James A.** An outline of materials for a postglacial bioclimatic history of Keewatin, Northwest Territories, Canada—U.S. Office Naval Research ONR Contract 1202(07), Tech. Rept. 15: Madison, Wis., Univ. Wisconsin Dept. Meteorology, 79 p., illus., table, 1964.

References from literature on glacial and botanical history of the Arctic particularly central Canada, are compiled, and some interpretations of the postglacial period are made. Recent discovery of a fossil podzol soil profile and C-14 dating of an overlying charcoal layer, identified as remains of a spruce forest extending about 175 miles north of the present forest border in Keewatin, indicates a postglacial period about 900 yr B.P. when the climate was similar to that now found in the belt south of the present treeline. During glaciations, at least the Wisconsin, the Arctic flora apparently survived in refugia north of the Brooks Range and on the western islands, and the boreal flora survived south of the ice. Hybrid forms in the now reoccupied areas indicate that some species had been split into two populations by the advancing ice.—V.M.J.

2644 **Lawrence, H. W.** In situ measurement of the elastic properties of rocks, *in* Symposium on rock mechanics, 6th, Rolla, Mo., 1964, Proc.: Rolla, Mo., Univ. Missouri, p. 381-390, illus., 1964.

Laboratory-determined dynamic constants are improving in reliability but are still subject to inaccuracies. Because of these laboratory shortcomings, an approach to in situ measurement is made through use of the acoustic-type well-logging tool. Instrumentation is described and illustrated in diagrams. The system is not universally applicable, as a fluid-filled hole is still a requirement, and all formations will not support measurable shear waves.—E.S.L.

2186 **Lazell, James D., Jr.** An Anolis (Sauria, Iguanidae) in amber: Jour. Paleontology, v. 39, no. 3, p. 379-382, illus., 1965.

Anolis electrum sp. nov.—described on the basis of two partial specimens in amber from Chiapas, Mexico—is believed to be Oligocene or Miocene in age. It is thus the earliest record of this lizard genus. The new species has the characteristic digital pads of *Anolis* very well developed and is unique in combining small, uniform middorsals, smooth, subimbricate ventrals, and small scales around the interparietal with unicarinate limb scales.—Author's abstract

2218 **Leckie, George Gallie.** Petrology of the Big Snowy Group, Amsden Formation, and Quadrant Sandstone at Sappington Canyon, Jefferson County, Montana [abs.]: Dissert. Abs., v. 25, no. 11, p. 6536, 1965.

2687 **Leeman, E. R.** Absolute rock stress measurements using a borehole trepanning stress-relieving technique, *in* Symposim on rock mechanics, 6th, Rolla, Mo., 1964, Proc.: Rolla, Mo., Univ. Missouri, p. 407-426, illus., tables, 1964.

A trepanning rock stress measuring technique is described based on the assumption that the direction of the borehole coincides with one of the minor principal stresses. Strain measurements are made on the flat end of the borehole which becomes the principal plane of the other minor principal stress and of the major principal stress. The accuracy of the stresses obtained depends upon the degree to which the rock is elastic, so that the amount of measured stress relief is the same as that of stress before trepanning. The relations between stresses on the end of a borehole and those in the surrounding rock are discussed, and the use of this technique on a dike in the East Rand gold mines is described.—E.S.L.

2219 **Leonard, Robert Benjamin, Jr.** Ground-water geology along the northwest foot of the Blue Ridge between Arnold Valley and Elkton, Virginia [abs.]: Dissert. Abs., v. 25, no. 11, p. 6536–6538, 1965.

2304 **Leopold, Luna B.; Emmett, William W.** Vigil Network sites—A sample of data for permanent filing: Internat. Assoc. Sci. Hydrology Bull., v. 10, no. 3, p. 12–21, illus., tables, 1965.

The Vigil Network consists of places where observations are made to record changes in landscape features over a long period of time. Resurveys usually are made once each year or every few years. Sites are chosen to represent some typical feature of a given landscape. The sample described here, to be included in the permanent repositories, is Last Day Gully near Hudson, Wyo. Cross-section information, distances and elevations for longitudinal profiles, and distances and elevations for cross-sectional profiles are tabulated.—E.S.L.

2179 **Leung, Samuel Seh-shue.** A comparison of magnetites from ores and host rocks of different geologic occurrences [abs.]: Dissert. Abs., v. 25, no. 10, p. 5864, 1965.

2416 **Levorsen, A. I.** The petroleum potential of the undrilled areas of the USA [abs.]: Tulsa Geol. Soc. Digest, v. 32, p. 172, 1964.

2629 **Lidz, Louis.** Sedimentary environment and foraminiferal parameters—Nantucket Bay, Massachusetts: Limnology and Oceanography, v. 10, no. 3, p. 392–402, illus., 1965.

A basic rectangular grid was used to take 168 samples. Sediments range from clay to gravel size, but the mean diameter of most is less than 500μ. A large percentage of the bottom is covered by quartz sands. Shell debris influences the mean diameter of samples from many parts of the bay. Detailed faunal analyses of 25 samples reveal certain trends that supplement sedimentary data. The foraminiferal species were counted, and foraminifera numbers, foraminifera–ostracod ratios, arenaceous–porcelaneous–hyaline ratios, and percentage of abnormal foraminifera were estimated.—E.S.L.

2220 **Lineback, Jerry Alvin.** Stratigraphy and depositional environment of the New Albany Shale (Upper Devonian and Lower Mississippian) in Indiana [abs.]: Dissert. Abs., v. 25, no. 11, p. 6538, 1965.

2354 **Little, H. W.** Geology, Salmo, British Columbia: Canada Geol. Survey Map 1145A, scale 1:63,360, text, 1965.

The stratigraphy of the Salmo area from the Precambrian Windermere system through Jurassic sedimentary exposed rocks and Tertiary plutonic rocks is described in some detail. Folds and faults of the area are examined in the light of most recent mapping and interpretations of the area.—M.C.M.

2620 **Lo, K. Y.; Stermac, A. G.** Failure of an embankment founded on varved clay [with French abs.]: Canadian Geotech. Jour., v. 2, no. 3, p. 234–253, illus., tables, discussions p. 254–260, 1965.

During the construction of a 19 ft high roadway embankment at New Liskeard, northern Ontario, on varved clay, a failure involving half the width of the embankment occurred, extending for a length of 350 feet. Investigation included continuous sampling and in situ vane tests to locate the failure zone in the foundation

clay. The results of this study show that: (a) The discrepancy between the in situ vane and laboratory tests on the varved clay is of the same order of magnitude as those in homogeneous deposits. (b) The $\pi = O$ analysis gives approximately correct safety factors. (c) The factors of safety given by effective stress analysis appear too high.—*from* Authors' abstract

2221 **Lohnes, Robert Alan.** Quantitative geomorphology of selected drainage basins in Iowa [abs.]: Dissert. Abs., v. 25, no. 11, p. 6538–6539, 1965.

2425 **Long, Richard A.** Ground water in the Geismar–Gonzales area, Ascension Parish, Louisiana: Louisiana Geol. Survey Water Resources Bull. 7, 67 p., illus., tables, 1965.

Maximum depth to which fresh water occurs in the Geismar–Gonzales area is about 600 feet in the central part, 0–300 feet in the southwest, and about 3,000 feet in the relatively undeveloped northeastern part. Aquifers are Miocene and Pliocene deposits, older and younger deltaic deposits, and alluvium of the Mississippi River. Water levels in wells range from a few feet above to about 20 feet below the land surface. The major problem is the potential contamination of freshwater aquifers by salt water that occurs downdip, laterally, and in the base of aquifers. Water with excessive hardness and high iron content is encountered in aquifers above a depth of about 300 feet.—M.C.M.

2503 **Longwell, Chester R.** Is uniformitarianism necessary?—A discussion [of paper by S. J. Gould, 1965]: Am. Jour. Sci., v. 263, no. 10, p. 918–919, 1965.

In discussion of Gould's paper [ibid., p. 223–228], Longwell comments that the essence of the Huttonian doctrine is an essential part of geologic science, but the cumbersome term should be replaced.—M.H.K.

Loud, Elisabeth S. *See* King, Ruth Reece. 2444

2403 **Love, D. W.** Karl A. Schmidt (1900–1965): Houston Geol. Soc. Bull., v. 8, no. 4, p. 15–17, portrait, 1965.

2355 **Lovering, T. S.; Morris, H. T.** Underground temperatures and heat flow in the East Tintic district, Utah: U.S. Geol. Survey Prof. Paper 504–F, p. F1–F28, illus., tables, 1965.

Temperature gradients, heat loss, and mean annual temperatures at the surface have been calculated for the East Tintic district on the basis of data from measurements of ground-water temperature, of rock temperatures in drill holes and in extensive mine workings, and of thermal conductivities in the laboratory and in the field. Data are tabulated and illustrated in graphs and on maps. The hottest waters sampled were saline, and analyses indicate that heat and mineral content are either of deep volcanic origin or that meteoric waters moving through Jurassic salt beds below major thrust faults have been mixed with volcanic emanations at depth. The Latite Ridge area is the most suitable for exploration for geothermal power; available data are inadequate for a complete appraisal of the possibility.—V.S.N.

2368 **Lustig, Lawrence K.** Clastic sedimentation in Deep Springs Valley, California: U.S. Geol. Survey Prof. Paper 352–F, p. 131–192, illus., tables, geol. map, 1965.

This report treats the size distribution of sedimentary deposits in Deep Spring Valley, Calif., and the formation of alluvial fans. Quantitative data on the largest particles and the slopes on which they occur, pebbles, and the granule-to-clay size fraction are given. Channels on alluvial fans and attendant features are described, and evolutionary, equilibrium, and climate hypotheses are presented for formation of the fans.—W.L.G.

2617 **Lustig, Lawrence K.** Sediment yield of the Castaic watershed, western Los Angeles County, California—A quantitative geomorphic approach: U.S. Geol. Survey Prof. Paper 422–F, p. F1–F23, illus., tables, 1965.

The problem of estimating the long-term sediment yield of the Castaic watershed in absence of hydrologic data is examined by a comparison between geomorphic parameters for six watersheds in the San Gabriel Mountains and those for the Castaic watershed. Sediment-area, sediment-movement, and several transport-efficiency factors are plotted against the known long-term sediment yield as simple regressions for the San Gabriel watersheds. The value of each parameter computed for the Castaic watershed is substituted into the appropriate regression-line equation for the San Gabriel Mountains and a series of sediment-yield values obtained; the yield of the Castaic is estimated at 250 acre-feet per yr. Other supporting factors are considered. Sediment size distribution studies and discussion of the net long-term channel erosion in the Castaic watershed are included.—V.S.N.

2351 **Luther, Edward T.; Hershey, Robert E.** Coal map[s] of the Richland, Sewanee, Number 12 and Lantana seam[s], Soddy quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 111-SW [sheets 2-4], scale 1:24,000, 1964.

These maps accompany the geologic map of the Soddy quadrangle by Luther and G. D. Swingle (1964) and the text by Swingle and Luther (1964).—M.C.M.

2353 **Luther, Edward T.; Swingle, George D.** Mineral resources summary of the Soddy quadrangle, Tennessee: Nashville, Tennessee Div. Geology, 14 p., tables, 1964.

This text accompanies Tennessee Div. Geology Geol. Map GM 111-SW by G. D. Swingle and E. T. Luther, and coal maps (same serial designation) by E. T. Luther and R. E. Hershey, which are cited separately. Coal-bearing rocks of the Soddy quadrangle are restricted to Walden Ridge and the lower ridge in the northeastern corner of the map area. The important coal seams are the Richland, Sewanee, Lantana, and No. 12 (Blanchard) coals, in the Crab Orchard Mountains Group of the lower Pottsville Series; the Richland has the greatest history of past mining, but the Sewanee contains the largest known recoverable reserves. One table locates mines by the Tennessee coordinate system, and another indicates representative analyses of the coals. Clay, chert, and shale have been mined and potential resources are sand, sandstone, limestone and dolomite, and iron.—M.C.M.

Luther, Edward T. *See* Swingle, George D. 2548

2411 **Lyons, Paul L.** The crust and mantle of the earth [abs.]: Tulsa Geol. Soc. Digest, v. 32, p. 169, 1964.

2442 **Mabey, Don R.** Gravity and aeromagnetic surveys, *in* Geology of the Cortez quadrangle, Nevada: U.S. Geol. Survey Bull. 1175, p. 105-111, illus., table, 1965.

Gravity data indicate that both Crescent and Grass Valleys [Cortez quadrangle] are underlain by several thousand feet of low-density Cenozoic rocks. Both valleys contain a wedge-shaped mass of Cenozoic fill on the depressed side of east- or southeast-tilted blocks. A single fault in Crescent Valley at the front of the Cortez Mountains coupled with lateral density variations within the valley fill could produce the measured gravity anomaly. At the north end of Grass Valley, a major fault is buried by the alluvium on the east side of the valley. A large deep-seated magnetic high occurs at the south end of the Cortez Mountains; strong local highs produced by basalt flows and dikes are superimposed on it. In the north end of the Toiyabe Range, relatively small irregular magnetic anomalies coincide with the area underlain by Tertiary volcanic rocks.—Author's abstract

Mabey, Don R. *See* Oriel, Steven S. 2518

MacKichan, K. A. *See* Conover, C. S. 2487

2506 **Macpherson, John.** Caribbean lands—A geography of the West Indies: London, Longmans, Green and Co., Ltd., 180 p., illus., tables, 1965.

While most of this book is devoted to geography, the first chapter covers the formation of the West Indies, and there are sections on geology and minerals in each of the twelve chapters on individual islands or groups of islands. Chapter 17 covers British Honduras.—E.S.L.

2437 **Malmberg, Glenn T.** Available water supply of the Las Vegas ground-water basin, Nevada: U.S. Geol. Survey Water-Supply Paper 1780, 116 p., illus., tables, 1965.

The area of about 3,000 sq mi described includes Las Vegas Valley, southern Indian Spring Valley, Three Lakes Valley, and northern Ivanpah Valley. The principal ground-water reservoir is the thick sequence of Miocene to Recent valley fill; water under leaky artesian conditions is found in deep, middle, shallow, and near surface zones. Average annual natural recharge to the reservoir is about 24,000 acre-feet; net draft on aquifers in 1955 was 48,000 acre-feet, with about 5,000 acre-feet discharged by phreatophytes and about 43,000 acre-feet by wells and springs. If the water table continues to decline at the same rate, it will be below the root zone of most phreatophytes by the year 2000.—W.L.G.

Maradudin, Alexei. *See* Bennett, Allan. 2426

Marlatt, W. E. *See* Moxham, R. M. 2566

2535 **Martens, James H. C.** Minerals of West Virginia: Morgantown, W. Va., West Virginia Geol. and Econ. Survey (Educ. Ser.), 41 p., illus., 1964.

This report includes a general discussion of the modes of formation and occurrence of minerals in West Virginia. Most of the minerals of the State are in sedimentary rocks and a few are in the small areas of igneous and metamorphic rocks. About forty minerals are discussed briefly and several more which are either rare or entirely microscopic are included in lists, classified as to origin. Mineral occurrences at about sixty localities in 18 counties are described. Most of the localities are in the folded rocks of the eastern part of the State.—Author's abstract

Marvin, R. F. *See* Coats, R. R. 2662

Marvin, Richard F. *See* Zartman, Robert. 2672

2167 **Marzke, Mary Ronald Walpole.** Evolution of the human hand [abs.]: Dissert. Abs., v. 25, no. 10, p. 5493, 1965.

Massoni, Camillo. *See* Shapiro, Leonard. 2669

Masursky, Harold. *See* Gilluly, James. 2441

2498 **Matthews, Robley Knight.** Genesis of recent lime mud in southern British Honduras [abs.]: Houston Geol. Soc. Bull., v. 8, no. 4, p. 21, 1965.

2193 **Mauger, Richard L.** Gamma-ray spectrometer studies of hydrothermally altered rocks [discussion of paper by R. M. Moxham, R. S. Foote, and C. M. Bunker, 1965]: Econ. Geology, v. 60, no. 8, p. 1734-1735, 1965.

In discussion of the paper by Moxham and others (ibid., v. 60, no. 4, p. 653-671, 1965), Mauger comments that potash enrichment might be the result of an igneous process rather than hydrothermal alteration.—W.S.W.

2265 **Maxwell, John C.** [Map] Geology of southwest Drummond area, *in* Geology of the Flint Creek Range, Montana—Billings Geol. Soc., 16th Ann. Field Conf. 1965: Billings, Mont., Billings Geol. Soc., plate 1, 1965.

2266 **Maxwell, R. A.; Dietrich, J. W.** Geologic summary of the Big Bend region, *in* Geology of the Big Bend area, Texas—Field trip guidebook: West Texas Geol. Soc. Pub. 65-51, p. 11-33, illus., tables, 1965.

Cretaceous-Tertiary stratigraphy and fossils comprise most of the paper and are shown in sections and charts. A section of the Paleozoic in the Marathon area is shown also. Discussions of surficial deposits, igneous intrusions, structure, and geologic history complete the paper.—E.S.L.

2638 **May, Irving; Jenkins, Lillie B.** Use of arsenazo III in determination of thorium in rocks and minerals, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525–D, p. D192–D195, illus., 1965.

A method for determining low concentrations of thorium in rocks and minerals, using the reagent arsenazo III, is described. Interference data are given for 29 elements that might affect the determinations. The general procedure includes separation steps with hydrofluoric acid, potassium hydroxide, and potassium iodate. A 1-gram sample is sufficient to determine ThO_2 content as low as 0.5 ppm. Authors' abstract

2339 **McBride, Earle F.; Thomson, Alan.** Sedimentology of the Tesnus Formation, Marathon region, Texas, *in* The filling of the Marathon geosyncline—Symposium and guidebook, 1964 field trip: Soc. Econ. Paleontologists and Mineralogists Permian Basin Sec. Pub. 64–9, p. 17–21, illus., 1964.

The Tesnus Formation represents the first stage in the filling of the Marathon geosyncline. It has the form of a clastic wedge that is more than 6,500 feet thick in the eastern part of the area, and thins to 300 feet toward the northwest. The formation is conformable with both the overlying Dimple Limestone and the underlying Caballos Novaculite. Faunal dates indicate that it includes rocks of Mississippian and Early Pennsylvanian age. Sands were probably introduced by turbidity currents and slump structures are abundant.—E.S.L.

2341 **McBride, Earle F.** Stratigraphy and sedimentology of the Gaptank Formation, Marathon Basin, Texas, *in* The filling of the Marathon geosyncline—Symposium and guidebook, 1964 field trip: Soc. Econ. Paleontologists and Mineralogists Permian Basin Sec. Pub. 64–9, p. 41–44, illus., 1964.

The Gaptank Formation is a sequence of complexly interbedded Pennsylvanian rock units of variable lithologies and facies relationships. It is conformable with the underlying Haymond Formation, but there is disagreement about the Permian contact. The lithology is described and the Gaptank is interpreted as transitional from the underlying flysch to the molasse unit in the upper part.—E.S.L.

McBride, Earle F. *See* Thomson, Alan. 2345

2545 **McBride, Earle F.** Sedimentology and stratigraphy of the Haymond Formation, Marathon Basin, Texas, *in* The filling of the Marathon geosyncline—Symposium and guidebook, 1964 field trip: Soc. Econ. Paleontologists and Mineralogists Permian Basin Sec. Pub. 64–9, p. 35–40, illus., 1964.

The Haymond Formation (Early Pennsylvanian) is a flysch sequence that records the culmination of deep water deposition in the geosyncline. It has a maximum thickness of 4,200 feet, more than two thirds of which is composed of thin beds of fine-grained olive-brown sandstone and black shale. Sandstones were deposited in deep water by turbidity currents. The boulder beds are interpreted as the product of submarine slides that transported fragments derived in part from thrust sheets.—*from* Author's abstract

McCabe, John A. *See* Cushman, R. V. 2145

2433 **McClellan, Guerry Hamrick.** Petrology of attapulgus clay in north Florida and southwest Georgia [abs.]: Dissert. Abs., v. 25, no. 11, p. 6539, 1965.

McConnell, R. K. *See* Tanner, J. G. 2308

2432 **McCormick, George Robert.** An investigation of the compatibility relations in the system MgO–GeO_2–MgF_2–LiF principally at 1000°C [abs.]: Dissert. Abs., v. 25, no. 11, p. 6670–6671, 1965.

2614 **McCracken, Mary H.** The Cambro-Ordovician rocks of northeastern Oklahoma and adjacent areas, *in* Symposium on the Arbuckle: Tulsa Geol. Soc. Digest, v. 32, p. 49–75, illus., tables, 1964.

The Cambrian–Ordovician section in the Ozark uplift area of Arkansas and Missouri has been known for some time. Using insoluble residue techniques, it has been extended into the subsurface of Oklahoma. Some grouping of units was necessary where they could not be differentiated. The structural history is given, formations described, and cross sections, chart, and isopach maps included. Well data are tabulated.—E.S.L.

McCulloch, David S. *See* Kauffman, Erle G. 2184

2252 **McGill, George E.** Tectonics of the northern Flint Creek Range, *in* Geology of the Flint Creek Range, Montana—Billings Geol. Soc., 16th Ann. Field Conf. 1965: Billings, Mont., Billings Geol. Soc., p. 127–136, illus., 1965.

Northern Flint Creek Range has a complex and varied set of structural features for such a small area. Disagreement among workers is not only on interpreting the sequence in which these structures developed, but also concerning relative movement on faults, and even the very existence of the major fault, the Philipsburg overthrust. The author presents two possible geometric interpretations, assuming either the presence or absence of a folded overthrust, and four possible chronological interpretations, with the aid of a tectonic map and cross sections.—E.S.L.

2311 **McGrain, Preston.** The application of new geologic maps to the economic growth of Kentucky: Lexington, Ky., Kentucky Geol. Survey, 13 p., illus., 1965.

New geologic maps prepared cooperatively by the Kentucky Geological Survey and the United States Geological Survey are proving beneficial to Kentucky's economic and industrial growth. These maps are proving useful in soils mapping, land use, and reforestation programs; water studies; construction projects; investigations for road materials; mineral resource exploration; education; and various aspects of industrial development. Industries related to agriculture, forestry, and minerals are already being assisted by this program. Eventually every segment of Kentucky's economy will be benefited.—Author's abstract

2222 **McGregor, Jackie Delaine.** Geology of the Ellsworth quadrangle and vicinity, Maine [abs.]: Dissert. Abs., v. 25, no. 11, p. 6539–6540, 1965.

2475 **McGuinness, C. L.; Meyer, Gerald.** West Virginia's water situation—The role of ground water: West Virginia Geol. Survey Newsletter, 7th issue, p. [2–6], illus., table, 1965.

Ground water accounted for only about three percent of the total withdrawal use of water in the State in 1960, but its importance is greater than this figure would indicate. The most productive aquifer is the alluvium along the Ohio River, and although the water is hard and contains some iron, its chemical quality is satisfactory; the aquifer is capable of yielding more than even the substantial current pumpage. Other potentially productive aquifers are the alluvium of the Kanawha valley and the limestone valleys of the Valley and Ridge province. The obvious water problems in the State are stream pollution and floods. A table shows representative chemical analyses of fresh ground water.—M.C.M.

2402 **McHugh, James W.; Broughton, M. N.** (editors). Symposium on the Arbuckle: Tulsa Geol. Soc. Digest, v. 32, p. 35–159, illus., tables, 1964.

The papers in this symposium cover the stratigraphy of the Arbuckle Group and oil and gas production from it in Oklahoma, Texas, Kansas, and Arkansas.—E.S.L.

2228 **McKague, Herbert Lawrence.** The geology, mineralogy, petrology, and geochemistry of the State Line serpentinite and associated chromite deposits [abs.]: Dissert. Abs., v. 25, no. 11, p. 6671, 1965.

McTaggart-Cowan, Gillian H. *See* Gupta, Ravindra N. 2627

Mead, Mildred Challman. *See* King, Ruth Reece. 2444

2460 **Mefferd, Dorothy.** Memorial to Ralph L. Mefferd (1909–1964): Geol. Soc. America Bull., v. 76, no. 11, p. P181, 1965.

2180 **Melson, William Gerald.** Geology of the Lincoln area, Montana, and contact metamorphism of impure carbonate rocks [abs.]: Dissert. Abs., v. 25, no. 10, p. 5864–5865, 1965.

2331 **Menard, H. W.** Discussion [of convection currents and continental drift], *in* A symposium on continental drift: Royal Soc. London Philos. Trans., ser. A, v. 258, no. 1088, p. 206–207, 1965.

The significance of the evidence for movement of volcanic islands adduced by Wilson (p. 145–167 of this symposium) is questioned on several grounds.—D.B.V.

2161 **Menzer, Frederick John, Jr.** Geology of the crystalline rocks west of Okanogan, Washington [abs.]: Dissert. Abs., v. 25, no. 12, pt. 1, p. 7204–7205, 1965.

2379 **Merriam, Daniel F.; Goebel, Edwin D.** The Asmussen oil field, Butler County, in southeastern Kansas, *in* Symposium on the Arbuckle: Tulsa Geol. Soc. Digest, v. 32, p. 91–97, illus., table, 1964.

The Asmussen oil field is located on the Nemaha anticline, on one of many faulted anticlines. It was discovered by subsurface mapping in 1957. Cumulative production from all zones in the Arbuckle at the end of 1963 was 1.3 million bbls. A cross section and two structure contour maps are included.—E.S.L.

2581 **Metzger, D. G.** A Miocene(?) aquifer in the Parker–Blythe–Cibola area, Arizona and California, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525–C, p. C203–C205, illus., table, 1965.

A fanglomerate which is a potentially important aquifer has been identified in outcrops and in wells near Parker, Blythe, and Cibola, in the Colorado River valley in California and Arizona. The fanglomerate, believed to be of Miocene age, is buried beneath Pliocene(?) estuarine deposits, and beneath younger deposits of the Colorado River, at most places where it is known. It is hydraulically separated from surficial river deposits by clay beds in the estuarine deposits, and the water level in several wells stands above the water table. The water is suitable chemically for irrigation, although its fluoride content makes it unsuitable for domestic water supply.—Author's abstract

2675 **Meyer, Charles.** An early potassic type of wall-rock alteration at Butte, Montana: Am. Mineralogist, v. 50, no. 10, p. 1717–1723, 1965.

Next to molybdenite-bearing quartz veins in some deep mine levels are narrow envelopes of alteration where feldspars and micas are altered to fine-grained muscovite, biotite, alkali feldspar (70 percent Or) and quartz, with anhydrite, carbonate, magnetite, hematite, pyrite, and chalcopyrite. These veins and envelopes are cut by white quartz veinlets without molybdenite or alteration which are themselves cut by fractures controlling the "main-stage" of mineralization.—E.H.R.

Meyer, Gerald. *See* McGuinness, C. L. 2475

2223 **Meyer, Harvey John.** Petrography of the Catskill Sandstone facies in central Pennsylvania [abs.]: Dissert. Abs., v. 25, no. 11, p. 6540, 1965.

2366 **Meyer, R. R.; Rollo, J. R.** Salt-water encroachment, Baton Rouge area, Louisiana: Louisiana Geol. Survey Water Resources Pamph. 17, 9 p., illus., 1965.

In the Baton Rouge area water is obtained from 10 principal aquifers and in the southern part salt-water fronts occur in each. Morgan and Winner (1964) analyzed existing data on rate of salt-water movement toward pumping centers and the present investigation further explores the situation. The correlation between two of the eight test sites, based on water levels and position of beds, indicates that a fault with a 350-ft displacement has caused hydraulic isolation of the deeper aquifers to the south; there has been little or no displacement of shallow aquifers

and, consequently, salt water is free to move northward in these beds toward pumping centers. This fault has materially changed the estimated direction and rate of flow of ground water in the area. Further drilling should establish the areal extent of the fault and its effect on ground-water movement and further salt-water contamination.—M.C.M.

2461 **Meyerhoff, Howard A.** Antillean tectonics: Bol. Inf., v. 8, no. 2, p. 41–46, illus., reprinted 1965; originally published 1954.

Geologic history of the whole Antilles arc is reviewed, and it is divided into units according to genetic relationships of the structures: the Cuban platform, Cayman fold mountains, Hispaniola fault mountains, Puerto Rican–Virgin Islands platform, and Lesser Antillean anticlinorium. The Greater Antilles have been squeezed between the Caribbean basin and Bahama foreland, causing the Cretaceous orogeny and deep-seated volcanism. Pressure was reapplied at the end of the Eocene and has continued. Greatest deformation occurred in Hispaniola and tear faults formed in Windward Passage and in Mona and Anegada passages. The Puerto Rican–Virgin Islands block acted as a competent monolith. The Lesser Antilles are a transverse range formed by rotation of the Caribbean basin.—E.S.L.

2181 **Meyertons, Carl Theile.** The geology of the Danville Triassic basin of Virginia [abs.]: Dissert. Abs., v. 25, no. 10, p. 5865, 1965.

2350 **Milici, Robert C.** Geologic map of the Grassy Cove quadrangle, Tennessee [and] Coal map of the Sewanee and Wilder seams . . .: Tennessee Div. Geology Geol. Map GM 117-SW, 2 sheets, scale 1:24,000, separate text, 1965.

The Pennsylvanian coal-bearing formations in the Grassy Cove quadrangle are the surface rocks throughout the map area. The Wilder seam is thin and discontinuous, whereas the Sewanee seam has yielded more coal and contains the only known reserves. Dimension sandstone is available from the Crossville and Newton Sandstones in adjacent areas. Fifteen formations containing limestone are exposed, but the better and more accessible limestone is from the Monteagle, Bangor, and Carters. Potential resources are sand, shale, and chert.—M.C.M.

2556 **Miller, J. A.; Fitch, F. G.** Geochronology and continental drift—The North Atlantic (with appendix by F. J. Fitch, "The structural unity of the reconstructed North Atlantic continent"), *in* A symposium on continental drift: Royal Soc. London Philos. Trans., ser. A, v. 258, no. 1088, p. 180–193, illus., tables, 1965.

An investigation of radiometric ages of metamorphic and granitic rocks and their geographic distribution on a reconstructed landmass could provide further evidence for continental drift. The distribution of rocks having apparent ages falling into the time spans 2,250–2,750, 1,520–1,890, 800–1,120, 380–440, 340–370, and 260–300 m.y. is discussed briefly, and results from areas of particular interest in the British Isles are considered in more detail. The 500-fathom line along the east coast of Greenland fits with that of northwestern Europe to form one unit, and that unit fits on to the 500-fathom line of Canada. The appendix presents and discusses a conical projection map of this reconstructed North Atlantic continent.—D.B.V.

Miller, Robert. *See* Bennett, Allan, 2426

2615 **Milton, Charles.** Mineralogy and geology of the Green River formation of Colorado, Utah, and Wyoming [abs.]: Tulsa Geol. Soc. Digest, v. 32, p. 169, 1964.

2182 **Misra, Krishna Kant.** Stratigraphy, sedimentation and petroleum possibilities of the Middle Ordovician (Kimmswick–Galena) rocks of Missouri, Illinois and Iowa [abs.]: Dissert. Abs., v. 25, no. 10, p. 5865–5866, 1965.

2162 **Moody, David Wright.** Coastal morphology and processes in relation to the development of submarine sand ridges off Bethany Beach, Delaware [abs.]: Dissert. Abs., v. 25, no. 12, pt. 1, p. 7205, 1965.

Moore, Donald O. *See* Eakin, Thomas E. 2481

Moore, George W. *See* Davis, Stanley N. 2528

Moore, H. D., Jr. *See* Bell, L. V. 2257

Moore, J. G. *See* Bateman, P. C. 2531

2400 **Morley, Harold T.** Charles R. Canfield (1906–1964): Tulsa Geol. Soc. Digest, v. 32, p. 29, portrait, 1964.

Morris, H. T. *See* Lovering, T. S. 2355

2183 **Morris, Robert Clarence.** A geologic investigation of the Jackfork Group of Arkansas [abs.]: Dissert. Abs., v. 25, no. 10, p. 5866–5867, 1965.

2190 **Morris, William J.** Graphic analysis of some Miocene horse astragali from California: Jour. Paleontology, v. 39, no. 4, p. 657–662, illus., 1965.

One hundred and forty-three equid astragali from two stratigraphically separated Miocene faunas from California show significant morphological differences between the two faunas and suggest that astragali may be valuable as stratigraphic indicators. In addition, the isolated astragali are related to equid taxa, which, for the most part, are based upon dental morphology. Two-dimensional studies based upon frequency distribution of selected morphological characteristics, together with topological surfaces formed by the junction of three morphological measurements, are useful analytical tools.—Author's abstract

2587 **Morrison, R. B.** New evidence of Lake Bonneville stratigraphy and history from southern Promontory Point, Utah, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-C, p. C110–C119, illus., 1965.

Pluvial-lake history revealed by study of new exposures on Promontory Point, Utah, is described in this report. Correlations are made of lacustral and dessication periods with Kansan and Illinoian Glaciations and Yarmouth and Sangamon Interglaciations. Several main interlacustral episodes are marked in the deposits by soil profiles; the newly named Promontory Soil, separating the Alpine and Bonneville Formations, is a well developed example.—W.L.G.

2686 **Moruzi, G. A.; Pasieka, A. R.** Evaluation of a blasting technique for destressing ground subject to rockbursting, *in* Symposium on rock mechanics, 6th, Rolla, Mo., 1964, Proc.: Rolla, Mo., Univ. Missouri, p. 185–204, illus., tables, 1964.

The use of blasting as a destressing technique applied to the hanging wall of a cut-and-fill stope in the Falconbridge mine, Ontario, which was subject to rock bursts, is reported. Fracture and photoelastic strain analyses were conducted on core samples taken shortly after the blast. It is doubtful that the blasts had any marked destressing effect. They may have triggered later rock bursts, and could have prevented stress build-up resulting in bursts of greater violence.—E.S.L.

2480 **Mound, Michael C.** A conodont fauna from the Joins Formation (Ordovician), Oklahoma: Tulane Studies Geology, v. 4, no. 1, p. 1–46, illus., table, 1965.

The Joins Formation has yielded more than 5,800 conodonts, which represent 56 species and 26 genera. Eleven species are described for the first time. The fauna has affinities with those previously described from Lower and Middle Ordovician rocks of the midcontinent and portions of the formation contain elements characteristic of Balto-Scandian faunas of Arenigian age. Work on the brachiopods and graptolites from previous Joins studies has indicated a transition between Chazyan and Canadian faunas. The present work corroborates these past studies and offers new evidence for the suggested age determination in the form of diagnostic conodonts.—*from* Author's abstract

2566 **Moxham, R. M.; Crandell, D. R.; Marlatt, W. E.** Thermal features at Mount Rainier, Washington, as revealed by infrared surveys, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-D, p. D93–D100, illus., 1965.

Aerial surveys with a scanning infrared radiometer over the summit cone of Mount Rainier volcano reveal thermal anomalies concentrated along the northern and western rims of the two summit craters that are no doubt related to well-known fumaroles along the crater walls. A complex reticulation of anomalies extends down the western flank of the cone to a poorly delineated arc which may coincide with a concentric structural element of the volcano. The present summit craters are offset toward the southeast of the axis of the volcano's central plug. The thermal anomalies lie in a similarly oriented pattern, but temperatures generally increase with distance from the axis of the central plug. Highest temperatures are associated with the youngest (east) crater, most distant from the central plug . . .—Author's abstract

Mrose, Mary E. *See* Kaye, Clifford A. 2667

Muffler, L. J. Patrick. *See* Brew, David A. 2515

2514 **Murata, K. J.; Bastron, Harry; Brannock, W. W.** X-ray determinative curve for Hawaiian olivines of composition Fo_{76-88}, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-C, p. C35-C37, illus., table, 1965.

When applied to Hawaiian olivines, Jackson's (1960) X-ray method for determining olivine composition yields a determinative curve that deviates appreciably from the previous established curve for plutonic olivines. The deviation, which is in the direction of a larger unit cell for a given Fo content, is due mainly to the substituent, calcium. Hawaiian olivines contain 0.2 to 0.5 percent CaO, which is an order of magnitude higher than the amounts in the plutonic olivines studied by Hotz and Jackson (1963).—Authors' abstract

2618 **Murata, K. J.** An acid fumarolic gas from Kilauea Iki, Hawaii: U.S. Geol. Survey Prof. Paper 537-C, p. C1-C6, tables, 1965.

A condensate of fumarolic gases, collected from the degassing pumice-cinder cone of Kilauea Iki during the 1959 eruption, proved to be essentially 2*N* HCl. The acid gases were observed to decompose surficial pumice thoroughly, leaving opaline pseudomorphs of pumice fragments and forming subsurface nodular deposits of mixed chlorides of aluminum, iron, magnesium, and other elements leached out of the pumice. Native sulfur deposits around the fumaroles contained almost 3 percent selenium.—Author's abstract

Murphy, John F. *See* Houston, Robert S. 2664

Murphy, Joseph. *See* Bennett, Allan. 2426

Murphy, Michael A. *See* Jones, David L. 2619

Murray, Haydn H. *See* Harrison, Jack L. 2243

2270 **Murray, James Wolfe.** Some stratigraphic and paleoenvironmental aspects of the Swan Hills and Waterways Formations, Judy Creek, Alberta, Canada [abs.]: Dissert. Abs., v. 25, no. 10, p. 5867, 1965.

2477 **Musgrove, R. H.; Foster, J. B.; Toler, L. G.** Water resources of the Econfina Creek basin area in northwestern Florida: Florida Geol. Survey Rept. Inv. 41, 51 p., illus., tables, 1965.

The Econfina Creek basin receives most of its water from rainfall, much of which is absorbed by highly porous, unconsolidated sands forming the water-table aquifer; seepage from this aquifer is to streams and underlying artesian aquifers. The productive artesian Floridan aquifer underlies the entire basin, and a secondary aquifer in the southern part is intermediate in depth to the water-table and the Floridan; movement is generally southwestward. Water leaks from the lakes to the Floridan aquifer at a rate proportional to the head between the lake surfaces and the piezometric surface of the aquifer. Springs contribute about 2/3 of the flow of Econfina Creek.—M.C.M.

2642 **Nair, O. B.; Udd, J. E.** Determination of the principal stresses in single pillars using an iterative method, *in* Symposium on rock mechanics, 6th, Rolla, Mo., 1964, Proc.: Rolla, Mo., Univ. Missouri, p. 391–406, illus., 1964.

The iterative method can be used if the magnitudes of the principle stress differences alone are known. It is basically a numerical solution of Laplace's equation, and gives the sum of the principal stresses at all points considered. This information, together with the known stress differences at the same points, makes it possible to determine the principal stresses. The advantage is that a clear picture of field–stress distributions from experimental results may be determined more rapidly. Use of an IBM 7040 computer simplifies the procedure.—E.S.L.

Nakagawa, H. M. *See* Lakin, H. W. 2599

2600 **Nakagawa, H. M.; Lakin, H. W.** A field method for the determination of silver in soils and rocks, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525–C, p. C172–C175, tables, 1965.

A rapid sensitive and specific field method useful in geochemical exploration has been developed for the determination of silver in geologic materials. In this method the sample is digested with nitric acid, and the silver is extracted with tri-isooctyl thiophosphate (TOTP) in benzene and stripped from the organic phase with dilute hydrochloric acid. Silver is then measured indirectly by its catalytic action on the persulfate oxidation of manganous ion to permanganate. The lower limit of sensitivity of the method is 0.01 ppm. Soils, rocks, oxides and sulfide ores have been analyzed, and the results agree favorably with analyses by fire assay. The data are also compared with results obtained by semiquantitative spectrographic analyses on concentrates of 23 different minerals. About 80 determinations can be made per man–day.—Authors' abstract

Nassichuk, W. W. *See* Strimple, H. L. 2541

2628 **Nauss, A. W.** The origin of mountains—A preliminary report: Diatomic Research Bull. 1, 40 p., illus., 1965.

For every downwarp there must be an equal and opposite upwarp. Isostatic theory requires that the equality be in terms of mass, not volume. Weights are shifted on the earth's surface by the process of erosion, transportation, and deposition at a rate of 3.45×10^{10} metric tons per year, not counting continental deposition. This causes an upbulging of the same amount, which is large enough to cause all mountains. Since gravity anomalies are not cumulative this upwarping may be considered as proved; only the shape of such bulges could cause argument. If the upbulging were worldwide, it would result in epeirogeny; if it were continent–wide, it would result in continent formation, and if narrow it would result in the formation of mountains. In any case, the process, although largely ignored until now, is of crucial importance to geology. It is the subject of this study.—Author's preface

Newcomb, L. E. *See* Callahan, J. T. 2438

2224 **Nichols, Maynard Meldrim.** Composition and environment of recent transitional sediments on the Sonoran coast, Mexico [abs.]: Dissert. Abs., v. 25, no. 11, p. 6540–6541, 1965.

2287 **Nielsen, Richard L.** Right–lateral strike–slip faulting in the Walker Lane, west–central Nevada: Geol. Soc. America Bull., v. 76, no. 11, p. 1301–1308, illus., 1965.

The Pilot Mountains, Gabbs Valley Range, Garfield Hills, and Soda Spring Valley, in southeastern Mineral County, Nev., are sliced into blocks by northwest–trending faults. Offsets in pre–Tertiary rocks indicate a total right–lateral strike–slip displacement of about 12 miles of which 10 miles is along the Soda Spring Valley fault. Faulting may have begun late in Miocene and continued until the Recent. The area of faulting is part of a zone of right–lateral strike–slip faulting in the western margin of the Basin and Range province.

Noble, D. C. *See* Sargent, K. A. 2385

2639 **Norris, Stanley E.; Fidler, Richard E.** Relation of permeability to particle size in a glacial outwash aquifer at Piketon, Ohio, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525 D, p. D203–D206, illus., 1965.

Significantly different types of particle-size distribution curves characterize two suites of sandy glacial outwash materials that have relatively lower and higher permeability, respectively. The material of lower permeability is well sorted medium to coarse sand for which the uniformity coefficient averages 6; the more permeable material ranges from coarse sand to coarse gravel and has an average uniformity coefficient of 13.9. The uniformity coefficients of the materials are reasonably good indexes of their respective permeabilities, whereas the 60-percent finer sizes and the effective particle sizes are poor indexes.—Authors' abstract

2328 **North Dakota Geological Survey.** Fourth supplement to well samples available for study at the North Dakota Geological Survey: Grand Forks, North Dakota Geol. Survey, 28 p., 1965.

Most of the oil and gas wells listed also have mechanical logs available. The references are to the North Dakota Geological Survey well numbers and correspond to the numbers in North Dakota Geol. Survey Circ. 5 (10th revision), 1965. M.C.M.

2511 **North Dakota Geological Survey.** List of cores available for study at the North Dakota Geological Survey, Supp. 1: Grand Forks, North Dakota Geol. Survey, 34 p., 1965.

This is a supplement to the list of cores dated Jan. 1963; for a complete list of cores available, both lists should be consulted. Stratigraphic nomenclature applied to the cored intervals is that currently in use by the North Dakota Geological Survey. Typical log characteristics of the Madison intervals may be checked by reference to their Reports of Investigation 35 (1960) and 30 (revised edition, 1965).—M.C.M.

2462 **North, F. K.** The curvature of the Antilles: Geologie en Mijnbouw, v. 44, no. 3, p. 73–86, illus., 1965; reprinted, Bol. Inf., v. 8, no. 2, p. 47–65, illus., 1965.

Geosynclinal belts of mid-Mesozoic, pre-Cretaceous age form much of the western edge of the Americas from Alaska to Baja California, and from coastal Peru to a point far south in Chile. They also appear in the curvilinear belt of the Greater Antilles, and in the row of islands off the north coast of South America. It is suggested that these orogenic sectors arose out of a compound geosyncline originally more or less straight, and that the violently convolute portion, from Guatemala to Puerto Rico and thence back to the Goajira Peninsula, has undergone progressively increasing northeasterly curvature as a consequence of tangential migration. This reached a limit with the impingement of the migrating arc against the old crystalline platform on which the Bahama Banks and Lesser Antilles now stand, and deformation was taken up by wrench faults and downtucks of oceanic crust.—*from* Author's abstract

2574 **Norton, J. J.** Lithium-bearing bentonite deposit, Yavapai County, Arizona, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525 D, p. D163–D166, illus., tables, 1965.

Samples of montmorillonitic clay from a deposit in and near the W 1/2 sec. 12, T. 13 N., R. 6 W., contains 0.3–0.5 percent Li_2O. Chemical and spectrographic analyses show that the clay is characterized by the unusual constituents Li, F, and Mg in amounts intermediate between normal montmorillonite and the end member, hectorite.—Author's abstract

2298 **Nova Scotia Department of Mines.** Geological map of the province of Nova Scotia: Halifax, Nova Scotia Dept. Mines, scale 1:506,880, 1965.

2370 **Nyman, Dale J.** Predicted hydrologic effects of pumping from the Lichterman well field in the Memphis area, Tennessee: U.S. Geol. Survey Water-Supply Paper 1819-B, p. B1-B26, illus., tables, 1965.

The Lichterman well field is scheduled to go into operation early in 1965 to supplement the municipal water-supply system for the city of Memphis, Tenn. The locality is currently under artesian conditions but when pumping begins the well field and much of the surrounding area will change to a water-table condition. Included in this report is a fence diagram showing the geology of the well field in detail, a contour map showing present and future water levels, hydrographs, and chemical analyses.—W.L.G.

Oder, Charles R. L. *See* Finlayson, C. Pratt. 2347

2314 **O'Keefe, J. A.** Discussion [of physics of convection currents in the Earth's mantle], *in* A symposium on continental drift: Royal Soc. London Philos. Trans., ser. A, v. 258, no. 1088, p. 272-275, illus., 1965.

The second harmonic of the geopotential is discussed in some detail, as it is the best established and largest deviation from fluid equilibrium. The load on the equator represented by the excess bulge is equivalent to 200 m of land elevation. Hydrodynamic support is required—that is, some sort of convection currents which produce forces that raise the equator as fast as it collapses. If mantle-deep convection currents really exist, and if they drag the continents around on their backs, then the continents should be stacked up either at the equator or at the poles.—D.B.V.

2567 **Oldale, R. N.; Tuttle, C. R.** Seismic investigations in the Harwich and Dennis quadrangles, Cape Cod, Massachusetts, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-D, p. D101-D105, illus., tables, 1965.

Subsurface data in the Harwich and Dennis quadrangles indicate that the top of the basement ranges from 180 to at least 555 feet below sea level. The basement, composed of crystalline rock of pre-Mesozoic age, is locally overlain by compact till a few tens of feet to 375 feet thick. Stratified drift 115 to 480 feet thick overlies the till. Valleys of Cretaceous(?) age cut the basement and indicate a change in relative sea level of at least 600 feet. The deepest of these valleys is filled in part by the till.—Authors' abstract

2497 **Olson, Henry David.** Mechanism of transverse petroleum migration [abs.]: Houston Geol. Soc. Bull., v. 8, no. 4, p. 20, 1965.

2518 **Oriel, Steven S.; Mabey, Don R.; Armstrong, Frank C.** Stratigraphic data bearing on inferred pull-apart origin of Gem Valley, Idaho, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-C, p. C1-C4, illus., 1965.

The possible origin of some filled basin range valleys as pull-aparts or tensional rifts on the back edge of a thrust plate was mentioned by Rubey and Hubbert in 1959. The concept was subsequently applied to Gem Valley, mainly as an interpretation of gravity and other data in the northern part of the valley [Mabey, 1963]. New stratigraphic information indicates that Paleozoic units on opposite sides of the valley contrast markedly in thickness and facies. Original sites of deposition, therefore, probably were not closer together than the 7 to 12 miles now separating the exposures.—Authors' abstract

Orkild, P. P. *See* Poole, F. G. 2388

2387 **Orkild, Paul P.** Paintbrush Tuff and Timber Mountain Tuff of Nye County, Nevada, *in* Changes in stratigraphic nomenclature by the U.S. Geological Survey, 1964: U.S. Geol. Survey Bull. 1224-A, p. A44-A51, illus., 1965.

2225 **Orlopp, Donald Easton.** Regional paleo-environmental study of some Middle Pennsylvanian strata of the Midcontinent region and textural analysis of included limestones [abs.]: Dissert. Abs., v. 25, no. 11, p. 6541, 1965.

2313 **Orowan, E.** Convection in a non-Newtonian mantle, continental drift, and mountain building, *in* A symposium on continental drift: Royal Soc. London Philos. Trans., ser. A, v. 258, no. 1088, p. 284–313, illus., 1965.

A condition for thermal convection has been derived for a mantle of non-Newtonian viscosity, with the properties of a crystalline material in the hot creep range. The critical magnitude of the yield stress at which convection can take place with plausible values of the dimensions of the hot column and of temperature practically coincides with the stress drop estimated from the energy release in deep-focus earthquakes; thus mantle convection appears probable. Explanations are offered for the oceanic ridges, relative incompressibility of continents, relative frequency of strike-slip earthquakes, asthenosphere, orogenesis, and geosynclinal subsidence. It is estimated that the Americas are moving westward at a rate of 1 cm per yr.—D.B.V.

2470 **Ostrom, M. E.** Cambro-Ordovician stratigraphy of southwest Wisconsin—Guidebook for the 29th annual Tri-State Geological Field Conference, Oct. 1965: Wisconsin Geol. and Nat. History Survey Inf. Circ. 6, 57 p., illus., table, 1965.

The Cambrian and Ordovician rocks of this area have long been recognized as a sequence of alternating layers of orthoquartzitic sandstones and of carbonate rocks, but the beginnings and ends of the cycles, their components, and their similarities and differences were not recorded. The purpose of this conference was to re-examine certain of these cyclic rocks, their large and small scale features and interrelationships, to test the validity of classical interpretations. The outcrops at 13 stops along the County Trunk Highway, from Genoa in Vernon County to Madison and south to New Glarus in Green County, are described, and a summary of the lithotypes of five cycles is given in the table.—G.D.C.

Overstreet, Elizabeth F. *See* Dunlap, John C. 2445

2192 **Owens, John S.** Development of magnetite in iron formations of the Lake Superior region [discussion of paper by G. L. LaBerge, 1964]: Econ. Geology, v. 60, no. 8, p. 1731–1734, 1965.

In western Mesabi, layers rich in magnetite are thinly interspersed with layers rich in siderite with minor silicates. In areas of abundant magnetite, degree of metamorphism is similar to that in areas of little magnetite. These relations are inconsistent with derivation of all magnetite from primary siderite and Fe silicates (LaBerge, ibid., v. 59, no. 7, p. 1313–1342, 1964).—W.S.W.

2436 **Owens, John S.** Origin of the Precambrian iron formations [discussion of paper by Henry Lepp and S. S. Goldich, 1964]: Econ. Geology, v. 60, no. 8, p. 1731–1734, 1965.

Iron content of units of unaltered Biwabik Formation range from 11 to 39 percent. These variations are clearly related to stratigraphy and seem incompatible with the homogeneity implied by the Lepp-Goldich model.—W.S.W.

Packard, Earl L. *See* Jones, David L. 2619

Pakiser, L. C. *See* Jackson, W. H. 2565

2305 **Pan Am. Union Dept. Econ. Affairs.** Mexico—Annotated index of aerial photographic coverage and mapping of topography and natural resources: Washington, D. C., Pan American Union, 33 p., illus., 1965.

The major geologic research and mapping agencies in Mexico include the Consejo de Recursos Naturales no Renovables (CRNNR), the Instituto de Geología of the Universidad Nacional Autónoma de México, Petróleos Mexicanos (PEMEX), and the Sección de Geología of the Secretaria de Recursos (SRH). The Comite de la Carta Geológica de México compiled a 1:2,000,000 scale geologic map of Mexico published by the Instituto de Geología in 1962. The Sección de Geología of the SRH is responsible for the production of hydrogeologic maps. PEMEX is compiling a 1:50,000 scale geologic map series covering large portions of northern and eastern

Mexico and the Isthmus of Tehuantepec. Other sources of geologic mapping are indicated in the text, and indexes are given for non-geologic maps.—M.C.M.

2653 **Panek, Louis A.; Hornsey, Edward E.; Lappi, Robert L.** Determination of the modulus of rigidity of rock by expanding a cylindrical pressure cell in a drillhole, *in* Symposium on rock mechanics, 6th, Rolla, Mo., 1964, Proc.: Rolla, Mo., Univ. Missouri, p. 427–449, illus., tables, 1964.

Modulus of rigidity of a rock can be determined by a procedure in which a cylindrical pressure cell is first calibrated by expanding it inside two metal test cylinders and then is expanded inside a drill hole in rock. The test cylinders have different expansion characteristics, which make possible the determination of two calibration constants. Change of diameter of the pressure cell is determined from the volume of fluid pumped into it. Some advantages of the method are that a rock sample and a diamond drill are not required, and the rock is tested in place.—E.S.L.

2231 **Pankratz, L. B.; King, E. G.** High-temperature heat contents and entropies of two zinc sulfides and four solid solutions of zinc and iron sulfides: U.S. Bur. Mines Rept. Inv. 6708, 8 p., tables, 1965.

Heat contents, measured above 298.15°K, and derived entropy increments are presented in tabular and equation form for the two crystalline forms of zinc sulfide, sphalerite and wurtzite, and for four solid solutions of iron and zinc sulfides. These new precise heat content data are 2 to 4 percent lower than those previously reported by Kelley as an evaluation of measurements by Bornemann and Hengstenberg on impure samples. The observed partial molal heat contents for pure FeS are nearly 50 percent greater than reported by Kelley at 600°K, and average more than 20 percent higher over the common temperature range of measurements. The data should be useful in obtaining free energies of formation from which thermal stabilities and chemical reactivities of the compounds and solid solutions can be obtained.—G.D.E.

Papadopulos, Istavros S. *See* Bredehoeft, John D. 2679

2650 **Parker, Jack; Scott, James J.** Instrumentation of room and pillar workings in a copper mine of the Copper Range Company, White Pine, Michigan, *in* Symposium on rock mechanics, 6th, Rolla, Mo., 1964, Proc.: Rolla, Mo., Univ. Missouri, p. 669–720, illus., table, 1964.

The principal objective of the rock mechanics investigations in this mine was to see whether room and pillar mining could be practiced on a large scale at the 2,000 ft level. Instrumentation of a test block of room and pillar mining is described. Problems associated with geology were low angle thrust faults, varying thickness and competence of the upper sandstone, varying thickness of parting shale, copper values in the lower sandstone, and joint planes. The application of instrumental data obtained to analysis of ground movements is discussed in detail. A geologic section of the ore body is given, and roof subsidence and rock movements are shown graphically.—E.S.L.

Parker, Jack. *See* Cummings, Bradford. 2661

Pasieka, A. R. *See* Moruzi, G. A. 2686

Pauszek, F. H. *See* Cushman, R. V. 2440

2375 **Pavlides, Louis; Griscom, Andrew; Kane, Martin F.** Geology of the Bridgewater quadrangle, Aroostook County, Maine: U.S. Geol. Survey Bull. 1206, 72 p., illus., tables, geol. map, 1965.

Glacial deposits of various types cover most of the Bridgewater quadrangle in eastern Aroostook County, Maine. These are underlain by weakly metamorphosed sedimentary rocks ranging in age from Ordovician through Devonian(?). The oldest and most extensive unit is the Meduxnekeag Formation (Ordovician). Various types of intrusive or crudely layered volcanic rocks underlie about 10 percent of the area

as small disconnected masses. Both sedimentary and volcanic rocks are highly folded, broken by faults, and transected by slaty cleavage. The rocks have undergone progressive regional metamorphism up to the greenschist facies; small plutons show no regional metamorphism but may have been retrogressively metamorphosed. Regional aeromagnetic and gravity survey results are included.—V.S.N

2271 **Payton, Charles Ellis.** Petrology and paleogeography of the Middle Creek, Bethany Falls, and Winterset (Pennsylvanian) Limestones [abs.]: Dissert. Abs., v. 25, no. 10, p. 5867–5868, 1965.

2250 **Pearson, Bruce; Greenlee, David W.** Paleozoic outcrops in the Santiago Mountains northwest of Persimmon Gap, *in* Geology of the Big Bend area, Texas—Field trip guidebook: West Texas Geol. Soc. Pub. 65–51, p. 39–41, illus., 1965.

Exposures of Paleozoic rocks occur along the axes of overturned and asymmetrical anticlinal folds, which sometimes culminate in thrust faults on the west and southwest and are broken by normal down-to-the-northeast faults on the northeast flank. The authors suggest that these structures may be the result of gravity sliding away from the center of the uplift, with some influence by the older structures. A geologic sketch map and sections are included.—E.S.L.

2281 **Pepin, Robert Osborne.** Isotopic anomaly patterns in meteoritic xenon [abs.]: Dissert. Abs., v. 25, no. 10, p. 6002, 1965.

Perry, T. G. *See* Utgaard, John. 2245

Peters, L. B., Jr. *See* Kennedy, L. E. 2360

Peters, L. B., Jr. *See* Kennedy, L. E. 2361

Peters, L. B., Jr. *See* Kennedy, L. E. 2362

Petkewich, R. M. *See* Ehinger, R. F. 2549

2202 **Petrascheck, Walther E.** Typical features of metallogenic provinces: Econ. Geology, v. 60, no. 8, p. 1620–1634, 1965.

"A metallogenic province is the entity of mineral deposits that formed during a tectonic-metallogenic epoch within a major tectonic unit and which are characterized by related mineral composition, form of the deposits, and intensity of mineralization." The concept of a metallogenic province is reviewed in terms of the following topics: regional-tectonic types of ore-bearing provinces; evolution of provinces in time; composition of ores characterizing the provinces; the form of ore deposits in individual provinces; density of mineralization.—W.S.W.

Petri, L. R. *See* Huxel, C. J., Jr. 2502

2484 **Pettyjohn, W. A.; Hills, D. L.** Geohydrology of the Souris River valley in the vicinity of Minot, North Dakota—Ground water basic data: North Dakota Water Comm., North Dakota Ground Water Study 65, 89 p., illus., tables, 1965.

Logs of test holes were compiled from drillers logs, sample analysis logs, and electric logs where available. Tables indicate depth to water in wells, subsurface conditions, geologic conditions and drilling characteristics of some rocks encountered, measurements of water-level fluctuations in observation wells, and chemical quality of water samples. Three interpretive reports describing the geology and hydrology, feasibility of artificial recharge, and results of an electric analog computer study of the Minot aquifer will be published at a later date.—M.C.M.

Pevear, D. R. *See* Ehinger, R. F. 2549

2595 **Pierce, Kenneth L.** Geomorphic significance of a Cretaceous deposit in the Great Valley of southern Pennsylvania, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-C, p. C152–C156, illus., 1965.

A lignitic terrestrial deposit of Late Cretaceous age appears to rest on more than 170 feet of residuum from carbonate rocks. After accumulation, probably in a sink, this deposit may have been lowered hundreds of feet by solution of the underlying carbonate rocks. This lowering of the deposit is consistent with regional rates of erosion and with evidence of lowering of other Appalachian surficial deposits. Author's abstract

2244 **Pinsak, Arthur P.; Shaver, Robert H.** The Silurian formations of northern Indiana: Indiana Geol. Survey Bull. 32, 87 p., illus., tables, 1964.

In northern Indiana, a disconformity appears to separate Silurian from older rocks. Six formations are described, of which the Salamonie Dolomite and Wabash Formation are new, and the Waldron Shale is changed to Waldron Formation. The Wabash Formation includes the Mississinewa Shale and Liston Creek Limestone Members (new rank). The term Huntington Lithofacies is given to reef lithologies, and the name Fort Wayne Bank is applied to the basin-fringing accumulations of vuggy biohermal dolomites in the Fort Wayne area. An appendix includes logs of cores and cross sections, and isopach and structure contour maps accompany the report.—E.S.L.

Piper, A. M. *See* Young, L. L. 2439

2143 **Podio, Augusto L.; Gray, K. E.** Single-blow bit tooth impact tests on saturated rocks under confining pressure—Pt. 1, Zero pore pressure: Soc. Petroleum Engineers Jour., v. 5, no. 3, p. 211–224, illus., 1965.

Berea and Bandera sandstone samples were impacted with both 3/4 in and 1/2 in long wedges at various confining pressures. Results indicate that viscosity of the pore fluid is influential primarily during early stages of crater formation. Differences in bit force, crater volume, and blow energy for tests parallel and perpendicular to bedding were significant, but decreased as the stress state was elevated. Crater volume, blow energy, and bit force were nonlinearly related to depth of penetration. Crater volume was nonlinear with energy of blow. Fixed penetration tests on saturated Berea yielded greater crater volume than did similar tests on dry samples. Differences in the nature of deformation for low values of bit penetration were noted between saturated and unsaturated samples.—G.D.C.

2558 **Poldervaart, Arie; Green, Jack.** Chemical analyses of submarine basalts: Am. Mineralogist, v. 50, no. 10, p. 1723–1728, illus., table, 1965.

Five new chemical analyses of four submarine basalts are presented. The two rocks from the Pacific are hypersthene-normative alkali basalts, whereas the two from the Atlantic are olivine-normative tholeiites.—Authors' abstract

Pollack, Sidney S. *See* Reid, Arch M. 2551

2386 **Poole, F. G.; Carr, W. J.; Elston, D. P.** Salyer and Wahmonie Formations of southeastern Nye County, Nevada, *in* Changes in stratigraphic nomenclature by the U.S. Geological Survey, 1964: U.S. Geol. Survey Bull. 1224-A, p. A36–A44, illus., 1965.

2388 **Poole, F. G.; Orkild, P. P.; Gordon, Mackenzie, Jr.; Duncan, Helen.** Age of the Eleana Formation (Devonian and Mississippian) in the Nevada Test Site, *in* Changes in stratigraphic nomenclature by the U.S. Geological Survey, 1964: U.S. Geol. Survey Bull. 1224-A, p. A51–A53, illus., 1965.

2319 **Popenoe, Peter.** Natural gamma aeroradioactivity map of the Denver area, Colorado: U.S. Geol. Survey Geophys. Inv. Map GP-505, scale 1:250,000, text, 1965.

The natural gamma aeroradioactivity in the Denver area ranges from 300–1,550 cps and is generally relatable to the gross composition of the surface material. Although the survey does not traverse any of the crystalline bedrock of the Front Range, debris from these rocks is the chief cause of the high radioactivity areas on the map. The text summarizes the geology related to the aeroradioactivity, and

the sheet includes a generalized geologic map of the area and an explanation of the instruments and methods used in compiling the radioactivity data.—M.C.M.

2406 **Prather, M. Rollin.** Gas occurrences in the Paleozoic rocks of western Alberta [abs.]: Tulsa Geol. Soc. Digest, v. 32, p. 164–165, 1964.

2272 **Prather, Thomas Leigh.** Stratigraphy and structural geology of the Elk Mountains, Colorado [abs.]: Dissert. Abs., v. 25, no. 10, p. 5868–5869, 1965.

2279 **Presnall, Dean Carl.** The join Mg_2SiO_4–$CaMgSi_2O_6$ iron oxide at oxygen pressures from 0.21 to 10^{-8} atmospheres [abs.]: Dissert. Abs., v. 25, no. 10, p. 5977, 1965.

2523 **Price, Don; Johnson, Nyra A.** Selected ground water data in the Eola–Amity Hills area, northern Willamette Valley, Oregon: Oregon State Engineer Ground Water Rept. 7, 55 p., illus., tables, 1965.

Occurrence, quality, and availability of ground water differ considerably from place to place in the Eola–Amity Hills area because of the highly diversified geologic and hydrologic conditions. A table relates the geologic situation to the availability of ground water for four areas—Eola–Amity Hills, east and west valley plains, and Willamette River flood plain. Tables show well and spring records, drillers' logs, and chemical analyses of ground water. The final interpretive report will be published by the U.S. Geological Survey.—M.C.M.

2247 **Price, Paul H.** Geologic maps as a basis for land classification: West Virginia Geol. Survey Newsletter, 8th issue, p. [1–5], illus., 1965.

There is a decided need for studies of all land areas and a classification of them as a guide to their best use. Geologic data should be a dominant factor in selection of the most advantageous use. Ground-water supply, drainage, foundation problems, and soil quality are some of things dependent on geology that are discussed.—E.S.L.

Pride, R. W. *See* Conover, C. S. 2487

2389 **Prinz, William C.** Marinette Quartz Diorite and Hoskin Lake Granite of northeastern Wisconsin, *in* Changes in stratigraphic nomenclature by the U.S. Geological Survey, 1964: U.S. Geol. Survey Bull. 1224-A, p. A53–A55, 1965.

2482 **Rainwater, Frank H.** Natural ground water quality problems: Jour. Soil and Water Conserv., v. 20, no. 6, p. 254–255, table, 1965.

Ground water supplies far exceed the volume of surface water contained in the lakes and streams of the United States. Each year these supplies become increasingly important to water users; consequently, ground water quality management is playing a more important role in water resources development. Ground water supplies 3/4 of the municipal water facilities of the United States and serves 1/3 of the nation. Examples of protection of supply and improvement of ground-water quality are summarized.—M.C.M.

Randall, A. D. *See* Cushman, R. V. 2440

2473 **Rateyev, M. A.** Modification degree of clay minerals during the stage of sedimentation and diagenesis of marine deposits, *in* Internat. Clay Conf., Stockholm, 1963, Proc., V. 2: London and New York, Pergamon Press (Internat. Ser. Mons. Earth Sci., V. 21), p. 171–180, illus., 1965.

An appraisal is given of possibilities of fundamental changes in structure of clay minerals in relation to ways of transport in the transition zone from catchment basin to marine environments and the zone of marine sedimentation itself. Concepts from a number of research studies of the last ten years in the eastern United States are reviewed, in particular clay mineral distribution in sediments of the Gulf of Mexico. The second part of the report deals with changes of clay minerals during diagenesis, with results of the author's studies offshore on the Caspian Sea.—G.D.C.

2429 **Ray, Clayton E.** A new chipmunk, *Tamias aristus*, from the Pleistocene of Georgia: Jour. Paleontology, v. 39, no. 5, p. 1016–1022, illus., 1965.

A new large chipmunk is described from a faunal assemblage at Ladds, Bartow County, Ga., that has yielded some 40 vertebrate species, including Pleistocene indicators. *Tamias aristus* is similar to the living *T. striatus*, but almost all its cranial and dental dimensions are 10–30 percent greater.—F.C.W.

2280 **Redmond, Charles Edward.** Genesis, morphology and classification of some till derived Chernozems of eastern North Dakota [abs.]: Dissert. Abs., v. 25, no. 10, p. 5977–5978, 1965.

Reed, Bruce L. *See* Detterman, Robert L. 2663

Reed, Bruce L. *See* Detterman, Robert L. 2666

2448 **Reesman, A. L.; Keller, W. D.** Calculation of apparent standard free energies of formation of six rock-forming silicate minerals from solubility data: Am. Mineralogist, v. 50, no. 10, p. 1729–1739, table, 1965.

Using aqueous solubility data at room temperature and the Debye–Hückel theory, standard free energies of formation from the elements were calculated for six silicate minerals. Because proof of solubility equilibrium is lacking, the values are tentative but do in general agree with existing values. The data (in kcal per mole) are: muscovite, –1328.7; nepheline, –476.8; microcline, –891.3; enstatite, –350.6; forsterite, –496.9; diopside, –725.—E.Z.

2551 **Reid, Arch M.; Bunch, Ted E.; Cohen, Alvin J.; Pollack, Sidney S.** Luminescence of orthopyroxenes: Nature, v. 204, no. 4965, p. 1292–1293, table, 1964.

The luminescence of orthopyroxenes and related minerals in meteorites, terrestrial minerals, and synthetic samples was examined. Luminescence was observed in orthopyroxenes containing little or no iron. All disordered orthopyroxenes showed luminescence, but there is no simple correlation between disorder and intensity and color of light emitted. Some correlation seems to exist between the character of the luminescence and either disorder in the structure or some effect closely related, perhaps cogenetic, with it.—D.B.V.

2605 **Reiser, H. N.; Lanphere, M. A.; Brosge, W. P.** Jurassic age of a mafic igneous complex, Christian quadrangle, Alaska, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-C, p. C68–C71, table, 1965.

Potassium–argon age determinations, one on plagioclase from diorite, the other on hornblende from leucogabbro, indicate that a large mafic igneous complex in the Christian quadrangle, northeastern Alaska, was emplaced in Jurassic time. Recently identified pollen and spores indicate that some of the intruded sedimentary rocks are in Triassic age.—Authors' abstract

Repenning, Charles A. *See* Walker, George W. 2296

2421 **Reynolds, Merrill J.** Geothermal energy exploration [abs.]: Tulsa Geol. Soc. Digest, v. 32, p. 176–177, 1964.

2533 **Rice, Charles L.** Geologic map of the Harold quadrangle, Floyd County, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-441, scale 1:24,000, section, text, 1965.

The Upper Elkhorn coal beds in the Harold quadrangle are the best in the area, are high-volatile A bituminous, and although they have been mined continuously for almost 50 years probably contain large reserves. The Fire Clay coal bed is probably the most persistent and uniform coal, ranging in thickness from 20 inches to 6 feet. The quadrangle is within the Big Sandy gas field, and gas is obtained from the Mississippian Pennington Formation and Greenbrier Limestone, Berea Sandstone (Devonian or Mississippian), and Devonian Ohio Shale. Other resources include sand and gravel, and shale.—M.C.M.

Richmond, Gerald M. *See* Weis, Paul L. 2590

2592 **Richmond, Gerald M.** Quaternary stratigraphy of the Durango area, San Juan Mountains, Colorado, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525–C, p. C137–C143, illus., tables, 1965.

Study of the type localities of Quaternary stratigraphic units defined by Atwood and Mather in 1932 in the Durango area shows that their Wisconsin moraines are of Pinedale age. Although some of their Durango moraines are of Bull Lake age, their type Durango moraine represents the youngest of three pre–Bull Lake glaciations, the Sacagawea Ridge Glaciation. The Florida Gravel is outwash of Sacagawea Ridge age and may represent two glacial advances. The Oxford Gravel is colluvium of middle to late Pleistocene age. The Bridgetimber Gravel and some deposits of the Bayfield Gravel represent outwash of two pre–Sacagawea Ridge glaciations, the Cedar Ridge and Washakie Point (older) glaciations. Other deposits of Bayfield Gravel are residually weathered from pre–Quaternary conglomerate.—Author's abstract

2188 **Richmond, Neil D.** Perhaps juvenile dinosaurs were always scarce: Jour. Paleontology, v. 39, no. 3, p. 503–505, 1965.

The age composition of some turtle populations shows that some reptile species consist of very few juveniles and many adults which mature early, live to great age, and have a long reproductive life. Large dinosaurs probably had such a population structure. Infant mortality in such a population would be very high.—F.C.W.

Rinehart, C. Dean. *See* Huber, N. King. 2530

Ripperger, E. A. *See* Thompson, Erik. 2654

2273 **Ritter, Dale Franklin.** Terrace development along the front of the Beartooth Mountains, southern Montana [abs.]: Dissert. Abs., v. 25, no. 10, p. 5869, 1965.

2659 **Roberts, A.** Progress in the application of photoelastic techniques to rock mechanics, *in* Symposium on rock mechanics, 6th, Rolla, Mo., 1964, Proc.: Rolla, Mo., Univ. Missouri, p. 606–648, illus., 1964.

Some current research is reviewed on applications of the photoelastic techniques in rock mechanics to investigation of the mechanism of failure in rock specimens under uniaxial compression, deformation of rock materials under load, and in model studies of mining and civil engineering structures using rocks and simulated rock materials. In the field, the technique has been extended by use of the surface biaxial optical gauge and photoelastic stressmeter and by development of a new system of in–situ measurement using photoelastic transducers.—V.S.N.

2255 **Roberts, A. E.** Cretaceous and lower Tertiary rocks near Livingston, Montana, *in* Geology of the Flint Creek Range, Montana—Billings Geol. Soc., 16th Ann. Field Conf. 1965: Billings, Mont., Billings Geol. Soc., p. 19–33, illus., 1965.

Lateral variation in lithology and thickness of Cretaceous and lower Tertiary rocks in southwestern Montana presents many problems in correlation. Brief descriptions of the formations and a correlation chart are presented to summarize Roberts' interpretation of stratigraphy in the Livingston area and relations with other areas in Montana and Wyoming.—E.S.L.

2517 **Robinson, S. C.** Data processing—A challenge to geologists: Am. Mineralogist, v. 50, no. 10, p. 1740–1745, 1965.

Geology has been handicapped more than any other science by the difficulty of comparing essential data. Concepts and theories are normally supported by maps and reports which are themselves the products of integration and interpretation of primary data. The techniques of data processing offer an opportunity to geologists to make data from field and laboratory available to their colleagues. These techniques can be used for descriptive data only if the observations, classifications and terminology are entirely objective and consistent.—Author's abstract

Roe, Richard B. *See* Bullis, Harvey R., Jr. 2492

2527 **Roedder, Edwin.** Liquid CO_2 inclusions in olivine-bearing nodules and phenocrysts from basalts: Am. Mineralogist, v. 50, no. 10, p. 1746–1782, illus., tables, 1965.

Inclusions of highly compressed, generally liquified, nearly pure CO_2 were found in various minerals of all olivine-bearing nodules from basalts studied, in phenocrysts from basalt, in some eclogite xenoliths, and in kimberlite. Most CO_2 inclusions are secondary but some appear to be primary; both types require the existence of immiscible globules of a dense supercritical CO_2 fluid in the magma at high pressures. Both types indicate 10–15 km depth at time of filling or final rehealing; inclusions formed at greater depths may have decrepitated on eruption. The CO_2 saturation of basalt (and other magmas) on a world-wide basis is significant in such petrological problems as vesiculation, composition of volcanic gases, origin of carbonatites, phenocrysts, and perhaps diamonds.—B.C.H.

2684 **Rohrer, W. L.; Gazin, C. L.** Gray Bull and Lysite faunal zones of the Willwood Formation in the Tatman Mountain area, Bighorn Basin, Wyoming, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-D, p. D133–D138, illus., 1965.

Vertebrate fossils common to the Gray Bull and overlying Lysite faunal zones overlap in a mappable claystone bed in the lower Eocene Willwood Formation. The bed, which crops out over more than 70 sq mi, is 2 to 10 feet thick and about 750 feet below the top of the Willwood. The claystone, herein identified as bed A, is a mollusk zonule that is considered to be a biostratigraphic and rock stratigraphic unit. Fragmentary fossils found in the mollusk zonule include mammals, fish, alligators, crocodiles, turtles, clams, and snails. The mollusks are indicative of a fresh-water environment.—Authors' abstract

Rollo, J. R. *See* Meyer, R. R. 2366

2604 **Rosholt, John N., Jr.; Ferreira, Carlos P.** Fractionation of uranium isotopes and daughter products in uranium-bearing sandstone, Gas Hills, Wyoming, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-C, p. C58–C62, illus., tables, 1965.

At a sandstone-type uranium deposit in the Wentz mine in Natrona County, Wyo., isotopic ratios of U-234/U-238 for 14 samples taken at, or just above, the present level of standing water show that the deposit has a relatively consistent U-234 deficiency ranging from 7 to 29 percent. Th-230/U-234 and Pa-231/U-235 ratios indicate that the time interval since uranium emplacement near the level of standing water is about 80,000 years and that the time interval generally is greater with increasing distance above the water. The source uranium also appears to be deficient in U-234, and the deficiency was maintained in ore by relatively continuous preferential leaching of this isotope.—Authors' abstract

2634 **Ross, Clarence S.** Paul F. Kerr's role in the development of clay mineralogy: Am. Mineralogist, v. 50, no. 10, p. 1548–1551, 1965.

The history is given of studies in clay mineralogy emphasizing the period 1925–1940. A bibliography lists the contributions of P. F. Kerr.—M.L.L.

2474 **Ross, David A.; Shor, George G., Jr.** Reflection profiles across the Middle America Trench: Jour. Geophys. Research, v. 70, no. 22, p. 5551–5572, illus., 1965.

Reflection profiles made in 1963 across the Middle America Trench from Panama to Tres Marías Islands show a syncline underlying the continental shelf in the Gulf of Tehuantepec and Gulf of Panama. A topographic bench part way down the landward flank of the Trench is underlain by a perched basin filled with 400 m or more of deformed sediments held by a linear ridge on the seaward side. The Trench bottom holds varying amounts of folded sediment (100 to more than 700 m). The Trench, interrupted by the Cocos ridge, may continue as far as Cape Mala,

Panama. The shelf and trench structure off the Gulf of Tehuantepec resembles the sedimentary troughs off northeastern North America.—D.B.V.

2274 **Rowan, Lawrence Calvin.** Structural analysis of the Quad–Wyoming–Line Creeks area, Beartooth Mountains, Montana–Wyoming [abs.]: Dissert. Abs., v. 25, no. 10, p. 5869–5870, 1965.

2163 **Roy, Edward Carl, Jr.** Pleistocene non–marine Mollusca of northeastern Wisconsin [abs.]: Dissert. Abs., v. 25, no. 12, pt. 1, p. 7206, 1965.

Rubin, Meyer. *See* Detterman, Robert L. 2666

2332 **Runcorn, S. K.** Palaeomagnetic comparisons between Europe and North America, *in* A symposium on continental drift: Royal Soc. London Philos. Trans., ser. A, v. 258, no. 1088, p. 1–11, illus., 1965.

Paleomagnetic evidence back to 1,200 m.y. indicates a systematic westward displacement, of the order of 20°–30°, of the polar wandering path deduced from American rocks from that deduced from European rocks. From the mechanics of the mantle–core system it appears certain that the mean geomagnetic field is axially symmetrical, and the possibility of an axial but nondipole field can be dismissed on paleoclimatic grounds. Therefore, the paleomagnetic data indicate that in pre–Triassic time Europe and North America were closer together and in low latitudes. Comparison of the Precambrian of western United States and the Keweenawan system suggests displacements within North America before the worldwide orogenic epoch of 1,000 m.y. ago.—D.B.V.

Rush, F. Eugene. *See* Everett, D. E. 2513

2187 **Russell, Loris S.** Body temperature of dinosaurs and its relationships to their extinction: Jour. Paleontology, v. 39, no. 3, p. 497–501, 1965.

As dinosaur skeletons resemble those of birds, the soft parts may also have been similar. Hence dinosaurs may have had separate arterial and venous circulations and may have been to some extent homoiothermic. They had no external insulation, however, and so were vulnerable to low temperatures such as appeared with the advent of seasonal climates in Late Cretaceous time.—F.C.W.

2141 **Rutten, M. G.** Ice–pushed ridges, permafrost, and drainage—A discussion [of paper by J. R. Mackay and W. H. Mathews, 1964]: Jour. Geology, v. 73, no. 6, p. 895–896, 1965.

Rutten infers that Mackay and Mathews [ibid., v. 72, no. 3, p. 378–380, 1964] have cast doubt on permafrost as a requisite for formation of ice–pushed ridges by stating that ponding, which should degrade permafrost, would have occurred along ice fronts that dam drainage systems. According to Rutten, such ridges exist preferentially where drainage was toward ice fronts; the ridges are genetically associated with permafrost formed because blocked drainage resulted in waterlogging but not ponding in front of the ice; the ridges record permafrost, and the permafrost shows that the area was not ponded.—D.R.M.

Saadallah, Adnan A. *See* Hagni, Richard D. 2201

2681 **Sainsbury, C. L.** Previously undescribed Middle(?) Ordovician, Devonian(?), and Cretaceous(?) rocks, White Mountain area, near McGrath, Alaska, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525–C, p. C91–C95, illus., 1965.

Marine carbonate and clastic rocks approximately 6,000–6,500 feet thick are dated by fossils as Middle(?) Ordovician and Devonian(?) in age. The marine strata are in fault contact along the Farewell fault with 8,100 feet of quartz conglomerate of Cretaceous(?) age. The rocks are unmetamorphosed.—Author's abstract

2340 **Sanderson, G. A.; King, W. E.** Paleontological evidence for the age of the Dimple Limestone, *in* The filling of the Marathon geosyncline—Symposium and guidebook,

1964 field trip: Soc. Econ. Paleontologists and Mineralogists Permian Basin Sec. Pub. 64–9, p. 31–34, illus., 1964.

Fusulinid genera and species referable to the Zone of *Fusulinella* and the Zone of *Profusulinella* are present in the Dimple Limestone, indicating an Atokan age for much of the formation. The oldest Dimple exposures apparently contain only a *Millerella* fauna and may be of Morrowan age. Present faunal evidence suggests that the Dimple becomes younger in a generally westward direction.—Authors' abstract

2385 **Sargent, K. A.; Noble, D. C.; Ekren, E. B.** Belted Range Tuff of Nye and Lincoln Counties, Nevada, *in* Changes in stratigraphic nomenclature by the U.S. Geological Survey, 1964: U.S. Geol. Survey Bull. 1224–A, p. A32–A36, illus., 1965.

2409 **Sarmiento, Robert.** Advances in logging technology [abs.]: Tulsa Geol. Soc. Digest, v. 32, p. 167–168, 1964.

2636 **Schaller, Waldemar T.** Paul F. Kerr—His years as secretary of the Mineralogical Society of America: Am. Mineralogist, v. 50, no. 10, p. 1546–1547, 1965.

The history of the Mineralogical Society of America is summarized for the period 1933–1937.—M.L.L.

2283 **Scheele, William E.; Hlavin, William.** I–71 fossil dig—Pt. 1, Some comments on the dig: Explorer, v. 7, no. 5, p. 4–11, illus., 1965.

Progress of the I–71 fossil salvage project of the Natural Science Museum, Cleveland, Ohio, in its first six months, March–August 1965, is summarized in a popular account. A work crew of 46 men, mostly Ohio college students, with Dr. David Dunkle of the Smithsonian Institution as scientific advisor, salvaged fossils from the Upper Devonian Cleveland Shale and its concretions in fresh road cuts and fill from highway excavation for the I–71 route. Some of the well-preserved arthrodires and other kinds of fishes are photographed and briefly described.—V.M.J.

2598 **Scheidegger, A. E.** On the statistics of the orientation of bedding planes, grain axes, and similar sedimentological data, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525–C, p. C164–C167, illus., table, 1965.

It is shown that the mean of a series of axes in space (normals to bedding planes, long axes of sand grains, and so forth) is not given by the vector mean of the individual axes (as commonly assumed in the literature), but should be calculated as the eigenvector of a certain symmetric matrix. This, then, represents the direct analog of taking the arithmetic mean value of linear data. It also is the correct extension of Krumbein's well-known method based on doubling the angle of circularly distributed data to three dimensions. An example is given.—Author's abstract

2226 **Schmincke, Hans-Ulrich.** Petrology, paleocurrents, and stratigraphy of the Ellensburg Formation and interbedded Yakima Basalt flows, south-central Washington [abs.]: Dissert. Abs., v. 25, no. 11, p. 6541–6542, 1965.

2434 **Scholten, Arnold Gerhard.** The reaction of phosphate with mineral surfaces and iron oxide gels [abs.]: Dissert. Abs., v. 25, no. 12, pt. 1, p. 6949–6950, 1965.

Schwarcz, Henry P. *See* Shaw, Denis M. 2465

2646 **Schwartz, Arnold E.** Failure of rock in the triaxial shear test, *in* Symposium on rock mechanics, 6th, Rolla, Mo., 1964, Proc.: Rolla, Mo., Univ. Missouri, p. 109–151, illus., tables, 1964.

An investigation was made to study rock failure phenomena as it occurs in high pressure triaxial shear tests. More than 160 tests were conducted, employing lateral pressures of zero to 10,000 psi and independently controlled pore pressures of zero to 5,000 psi. Core samples of Indiana limestone, Georgia marble, Stone Mountain

granite, and Pottsville sandstone were tested. The failure surfaces were examined using photomicrographs. It was concluded from this study that confining pressures influence failure mode, the angle of slip is closely predicted by the Mohr criterion, and an additional parameter, "fracture interference", may be included in the shear strength equation.—Author's abstract

2451 **Schwerdtner, W. M.; Tou, J. C.-M.; Hertz, P. B.** Elastic properties of single crystals of anhydrite: Canadian Jour. Earth Sci., v. 2, no. 6, p. 673–683, illus., tables, 1965.

The nine moduli of compliance for anhydrite were obtained in uniaxial compression tests. The displacements were measured by stráin gauges of an electrical resistance variety (Budd MetalFilm). Geophysical constants for the polycrystalline aggregates were also computed.—Authors' abstract

Scott, James J. *See* Parker, Jack. 2650

2499 **Scott, Robert B.** The Tertiary geology and ignimbrite petrology of the Grant Range, east central Nevada [abs.]: Houston Geol. Soc. Bull., v. 8, no. 4, p. 23, 1965.

2315 **Seeland, David A.; Wilshire, Howard G.** Geologic map of part of the Rushing Creek quadrangle in southwestern Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ–445, scale 1:24,000, section, text, 1965.

Limestone of the Warsaw Formation may be suitable for road metal and concrete aggregate, but outcrops are discontinuous and the amount of unweathered limestone available is unknown. Gravel for road metal is excavated intermittently from deposits of Pliocene(?) and Pleistocene age and from the Tuscaloosa Formation.—M.C.M.

2577 **Seiders, Victor M.** Volcanic origin of flint clay in the Fire Clay coal bed, Breathitt Formation, eastern Kentucky, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525–D, p. D52–D54, illus., 1965.

The flint-clay parting of the Fire Clay coal bed in the Breathitt Formation of eastern Kentucky is composed chiefly of kaolinite and sparse angular grains of quartz and sanidine. The mineralogy and texture indicate that the rock formed by alteration of volcanic ash in a coal swamp.—Author's abstract

SEPM. *See* Am. Assoc. Petroleum Geologists. 2466

2338 **SEPM, Permian Basin Section.** The filling of the Marathon geosyncline—Symposium and guidebook, 1964 field trip: Soc. Econ. Paleontologists and Mineralogists Permian Basin Sec. Pub. 64–9, 91 p., illus., geol. map, 1964.

Ten technical papers cover the forming and filling phases of the Marathon geosyncline as background for two field trips in the Marathon area, Texas. A correlation chart and geologic map are included.—E.S.L.

2648 **Serata, Shosei.** Theory and model of underground opening and support system, *in* Symposium on rock mechanics, 6th, Rolla, Mo., 1964, Proc.: Rolla, Mo., Univ. Missouri, p. 260–292, illus., tables, 1964.

The triaxial properties of rocks and the underground stress field were studied in order to establish a theoretical basis for mathematical analysis of underground structures. The concept of continuum mechanics was applied successfully. Rock salt of uniform quality was used as a model material to verify the theories because it possesses the important characteristics of rocks in general. The theoretical conclusions of the behavior of the opening and support systems were tested by using various analog models of the structures made of the model material.—E.S.L.

2227 **Seyfert, Carl Keenan, Jr.** Geology of the Sawyers Bar area, Klamath Mountains, northern California [abs.]: Dissert. Abs., v. 25, no. 11, p. 6542, 1965.

2476 **Shafer, G. H.** Ground-water resources of Gonzales County, Texas: Texas Water Devel. Board Rept. 4, 89 p., illus., tables, geol. map, 1965.

The stratigraphic units in Gonzales County range from the Paleocene Midway Group to Recent alluvium; their thickness, lithology, age, and water-bearing properties are discussed and summarized in a table. The formations dip to the southeast at an angle slightly greater than the slope of the land surface and most thicken in the same direction. The rocks have been cut by many normal faults, mainly in the southeastern half of the County. Most of the ground water (80 percent) is obtained from the Carrizo Sand; less than ten percent comes from the Queen City and Sparta Sand. The water is suitable for most uses. The availability for future development is discussed, and tables of well records, drillers' logs, and chemical analyses are included.—M.C.M.

2669 **Shapiro, Leonard; Massoni, Camillo.** Automatic sample changer and controller for an X-ray quantometer, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-D, p. D178-D183, illus., 1965.

The automatic sample changer and controller described replaces the manual sample changer of the ARL 10-channel X-ray fluorescence quantometer used in rapid rock analysis. The unit permits exposure of 32 samples to the X-ray beam, in sequence and under vacuum conditions, and automatically controls the various steps of the X-ray analysis up to, and including, the final print-out of characteristic X-ray intensities.—Authors' abstract

2203 **Sharp, W. E.** The deposition of hydrothermal quartz and calcite: Econ. Geology, v. 60, no. 8, p. 1635-1644, illus., table, 1965.

The presently available data on the thermodynamic properties of water and the solubilities of quartz and calcite suggest the following conclusions: (1) Both calcite and quartz can be deposited when two solutions of different temperatures are mixed at constant pressure. (2) Quartz deposition should predominate over calcite above 300°C but calcite should predominate at temperatures below 150°C when pressure-temperature changes in rising solutions cause the precipitation. (3) Replacement of quartz by calcite and calcite by quartz may be caused by transport of $CaCO_3$ and SiO_2 along thermal gradients.—Author's abstract

Shaver, Robert H. *See* Pinsak, Arthur P. 2244

2465 **Shaw, Denis M.; Schwarcz, Henry P.; Sheppard, Simon M. F.** The petrology of two zoned scapolite skarns: Canadian Jour. Earth Sci., v. 2, no. 6, p. 577-595, illus., tables, 1965.

A spheroidal skarn body at Gib Lake, Pontiac County, Quebec, occurs in phlogopite marble, and shows concentric zones several centimeters thick. The zonal sequence is: core of blue scapolite; pargasite-albite intergrowth; pure phlogopite; serpentinized forsterite-dolomite marble. The minerals have been analyzed. A zoned skarn with a similar sequence was found 15 mi south on Calumet Island. Phase assemblages are consistent with upper amphibolite facies metamorphism. The zonal sequence is explained by reaction between a spheroidal quartzofeldspathic mass and an enveloping dolomitic marble through radial diffusion of Mg inward and Si, Al outward, establishing local equilibrium between adjacent phases.—*from* Authors' abstract

2668 **Sheppard, Richard A.; Gude, Arthur, J., 3d.** Zeolitic authigenesis of tuffs in the Ricardo Formation, Kern County, southern California, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-D, p. D44-D47, illus., tables, 1965.

Vitric tuffs in the Ricardo Formation of the El Paso Mountains are altered to clinoptilolite, opal, and (or) montmorillonite. The pattern of alteration indicates that the alteration was accomplished by subsurface meteoric water after the formation was tilted northwestward. A comparison of chemical analyses indicates that the formation of clinoptilolite from rhyolitic glass involves mainly gains of H_2O and CaO and losses of SiO_2 and K_2O.—Authors' abstract

Sheppard, Simon M. F. *See* Shaw, Denis M. 2465

Sheridan, M. F. *See* Brophy, G. P. 2633

Shor, George G., Jr. *See* Ross, David A. 2474

Silver, L. T. *See* Wetherill, G. W. 2453

2455 **Silver, L. T.** Compilation of Phanerozoic geochronological data for Western North America, *in* Geochronology of North America: Natl. Acad. Sci.—Natl. Research Council Nuclear Sci. Ser. Rept. 41 (NAS-NRC Pub. 1276), p. 221–297, tables, 1965.

Absolute age data are tabulated for rocks of Phanerozoic age from Yukon, Mackenzie, Franklin, Minnesota, North Dakota, Montana, Idaho, Washington, Oregon, Wyoming, Nebraska, Utah, Colorado, Nevada, California, Oklahoma, Texas, New Mexico, Arizona, and Mexico.—V.S.N.

2261 **Silverman, Arnold.** Economic geology of the Flint Creek Range, *in* Geology of the Flint Creek Range, Montana—Billings Geol. Soc., 16th Ann. Field Conf. 1965: Billings, Mont., Billings Geol. Soc., p. 108–119, illus., 1965.

The Philipsburg district has accounted for most of the mineral production of the Flint Creek Range area. Mineral products include gold, silver, manganese, lead, zinc, iron, minor copper, phosphate, and limestone. The pre-Cretaceous geologic history is given briefly as background for a discussion of ore genesis. Types of ore deposits in the district are described, and a sketch map shows the relation of veins to different formations.—E.S.L.

2327 **Simmons, Gene.** Ultrasonics in geology: IEEE Proc., v. 53, no. 10, p. 1337–1345, illus., 1965.

Ultrasonics is used in geology for the determination of elastic properties of rocks and minerals. For measurements on rocks, techniques with precisions of a few percent have come into use; these measure delay times of elastic waves propagating through specimens several inches long. For single crystals, the techniques are the same as those used in solid-state physics; they are basically interferometric methods. Techniques of measurement are reviewed. An extensive bibliography is included.—Author's abstract

2369 **Simpson, Thomas A.** Geologic and hydrologic studies in the Birmingham red-iron-ore district, Alabama: U.S. Geol. Survey Prof. Paper 473-C, p. C1–C47, illus., tables, geol. map, 1965.

The geology and occurrence of ground water in the mines of the Birmingham red-iron-ore district are described in this report. Several applications of ground-water hydraulics are presented, and several methods are suggested to show how the Shannon fault zone in the district might be dewatered. Included are geologic and subsurface maps, a fence diagram, and logarithmic and semilogarithmic graphs of a pumping test in Pyne mine.—W.L.G.

2204 **Sinclair, A. J.** Volume of source rocks of the radiogenic component of multistage (anomalous) leads: Econ. Geology, v. 60, no. 8, p. 1709–1717, illus., tables, 1965.

Intercomparison lead isotope abundances of galenas from the Kootenay district, British Columbia, are used to illustrate the application of multistage lead lines to determination of volume of source rocks of the radiogenic lead component. Calculations indicate that relatively small volumes of crustal rocks (less than 10 cubic kilometers) could supply the radiogenic component of some multistage lead deposits if only one-third of the radiogenic lead were extracted. Volumes determined from multistage lead data agree well with a more common method of volume estimation.—Author's abstract

2302 **Sinclair, G. Winston.** Succession of Ordovician rocks at Lake Timiskaming: Canada Geol. Survey Paper 65-34, 6 p., 1965.

Ordovician outliers on the Canadian Shield near Lake Timiskaming comprise four major lithic units; these units in ascending order are sandstone, shales, limestone, and shales. Formation names are proposed for the four units which are all assigned to the Liskeard Group. The youngest formation is of Edenian age, the oldest is of Wilderness age.—Author's abstract

2602 **Slack, Keith V.; Fisher, Donald W.** Light-dependent quality changes in stored water samples, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-C, p. C190-C192, table, 1965.

Composition of replicate samples of natural water stored in polyethylene bottles of three degrees of transparency was nearly identical after storage. After exposure for 3 months to alternating 12-hour light and dark periods, pH ranged from 9.27 to 10.17, HCO_3 was not detected in most samples, CO_3 concentration ranged from 7 to 13 ppm, and free CO_2 and NO_3 were below detection. After an additional 2 months of dark storage, pH had decreased 2 units relative to that of the samples during illumination, concentration of free CO_2 and HCO_3 had increased greatly, and CO_3 was below detection. Observed changes are attributed to photosynthesis by algae which developed in the samples during illumination, and to re-solution of substances following death and decay of the algae in the dark.—Authors' abstract

2199 **Slaughter, Bob H.** Simple reproduction of enamel patterns of equine teeth: Jour. Paleontology, v. 39, no. 1, p. 165, illus., 1965.

The sawed surface of the tooth is submerged for about two minutes in a 50 percent solution of hydrochloric acid and water. The acid attacks the dentine and leaves the enamel in relief. Printer's ink is applied to the prepared tooth with a roller, and a print made on smooth poster board.—F.C.W.

2299 **Smith, Arthur R.** (compiler) Geologic map of California, Bakersfield sheet—Olaf P. Jenkins edition: San Francisco, Calif., California Div. Mines and Geology, scale 1:250,000, separate explanatory sheet, 1964.

Smith, Philip M. *See* Watson, Richard A. 2139

2232 **Smith, R. M.; Stamey, W. L.** Determining the range of tolerable erosion: Soil Sci., v. 100, no. 6, p. 414-424, 1965.

Leading soil scientists have suggested that accelerated soil-erosion rates much greater than "normal" or "geologic" should not be tolerated. Control erosion plots at 12 locations in humid regions indicate that normal slope erosion ranges from 0.1 to 0.6 ton per acre annually. It is much higher on extreme slopes where rainfall is deficient for plant growth. Rock weathering, as a source of soil renewal, is highly variable with time, nature of rock, depth of regolith, and intensity of agents. An average of about 0.2 ton per acre annually in central U.S. is an estimate. The present knowledge is far from adequate for achieving soil erosion tolerances, except by introducing land use and erosion control or renewal practices that are not acceptable to a great many farm operators.

Snyder, George. *See* Zartman, Robert. 2672

Soc. Econ. Geologists. *See* Am. Assoc. Petroleum Geologists. 2466

Sorcic, Rudolph. *See* Gilley, James L. 2660

Spencer, Charles W. *See* Larrabee, David M. 2446

2641 **Spokes, Ernest M.; Christiansen, Carl R.** (editors). Symposium on rock mechanics, 6th, Rolla, Mo., Oct. 1964, Proc.: Rolla, Mo., Univ. Missouri, 773 p., illus., tables, 1964.

The theme of the symposium is the practical application of rock mechanics theory. It is intended as a forum for the many disciplines which deal with geologic materials. Thirty-three papers are included.—E.S.L.

2405 **Sproule, J. C.** Professional certification and registration and the AAPG [discussion of paper by author, 1964] [abs.]: Tulsa Geol. Soc. Digest, v. 32, p. 161–162, 1964.

2521 **Staatz, Mortimer H.; Griffitts, Wallace R.; Barnett, Paul R.** Differences in the minor element composition of beryl in various environments: Am. Mineralogist, v. 50, no. 10, p. 1783–1795, illus., tables, 1965.

The range in abundance of certain elements is different in beryls from different environments, and these differences are so large that the environment of most beryls can be determined from their composition. The various indicative elements are given for beryls from pegmatite, wallrock adjacent to pegmatite, veins, granite, and rhyolite.—*from* Authors' abstract

2576 **Staatz, Mortimer H.; Adams, John W.; Conklin, Nancy M.** Thorium-bearing microcline-rich rocks in the southern Caballo Mountains, Sierra County, New Mexico, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-D, p. D48–D51, illus., table, geol. map, 1965.

Anomalously radioactive rocks, consisting chiefly of brick-red microcline, are found as elongate bodies as much as 300 feet long in quartz monzonite in the southern Caballo Mountains. These rocks, believed to be comparable in origin to fenites, are thought to have been produced by the reaction of alkalic solutions on the quartz monzonite. The solutions probably originated with unspecified alkalic rocks located at some unknown depth or distance from the microcline-rich bodies. Most of the radioactivity of the microcline-rich bodies is due to thorium contained in thorite. Uranium is present locally in uranophane, and the rare-earth fluorocarbonate, bastnaesite, was found in one deposit.—Authors' abstract

Stamey, W. L. *See* Smith, R. M. 2232

2522 **Staples, L. W.** Zeolite filling and replacement in fossils: Am. Mineralogist, v. 50, no. 10, p. 1796–1801, illus., 1965.

Analcime, heulandite, and stilbite occur in the Oligocene Eugene Formation near Eugene, Oreg., filling cavities in gastropods and pelecypods. Heulandite and stilbite also replace the shells. Other associated minerals are calcite, pyrite, and nontronite. The zeolitization is associated with intrusion of basaltic dikes and is not related to the more usual process of devitrification of volcanic rocks. Similar occurrence of heulandite and stilbite is noted at Gillespie Butte near Eugene.—E.Z.

2486 **Starkey, John.** A preliminary orienting procedure for single crystals, using the Weissenberg camera [with German abs.]: Zeitschr. Kristallographie, v. 122, nos. 1–2, p. 73–80, illus., 1965.

A technique is described using unscreened Weissenberg photographs to determine the absolute orientation of a crystal relative to the axis of the goniometer head on which it is mounted. The photographs are interpreted by means of specially constructed charts, and the derivation of the charts and their application are discussed. The orientation is represented in stereographic projection, permitting immediate determination of angular corrections which must be made to bring any desired crystallographic direction into coincidence with the goniometer axis. This technique is applicable only when indexed Weissenberg diffraction photographs are available, so it is especially useful where several specimens of the same material are being investigated.—*from* Author's abstract

Steiger, R. H. *See* Tilton, G. R. 2307

Stellmack, John A. *See* White, William B. 2140

2292 **Stellmack, John A.** An alpine karst in the United States [abs.], *in* Internat. Cong. Speleology, 4th, Yugoslavia, 1965, Summ. Lectures: Ljubljana, Yugoslavia, Speleol. Soc. Yugoslavia, p. 54, 1965.

Stephens, E. Vernon. *See* Denson, Norman M. 2424

Stermac, A. G. *See* Lo, K. Y. 2620

Stern, T. W. *See* Coats, R. R. 2662

Stern, Thomas W. *See* Zartman, Robert. 2672

2616 **Stewart, John H.** Precambrian and Lower Cambrian formations in the Last Chance Range area, Inyo County, California, *in* Changes in stratigraphic nomenclature by the U.S. Geological Survey, 1964: U.S. Geol. Survey Bull. 1224-A, p. A60–A70, illus., 1965.

Stiles, David V. *See* Ehlers, Ernest G. 2144

2490 **Storms, W. H.; Fairbanks, Harold W.** Old mines of southern California—Desert-mountain-coastal areas, including the Calico-Salton Sea-Colorado River districts and southern Counties: Toyahvale, Tex., Frontier Book Co., 96 p., illus., reprinted 1965; originally published 1893.

The general geology of mine areas in Los Angeles, San Diego, Orange, and San Bernardino Counties is reprinted from the Report of the California State Mineralogist for 1893.—M.C.M.

2258 **Strickler, Bill; Zeisloft, Jon.** Detrital dolomite in the Maywood and Amsden(?) Formations, Granite County, Montana, *in* Geology of the Flint Creek Range, Montana—Billings Geol. Soc., 16th Ann. Field Conf. 1965: Billings, Mont., Billings Geol. Soc., p. 73–78, illus., 1965.

The authors consider the occurrence of detrital dolomite in two formations of similar lithology to be significant because it may indicate a fluvial environment rather than marine, and because its presence is easily overlooked in thin sections; its description here may aid in recognition in the future. Twenty-one thin sections from the Maywood and 15 from the Amsden were stained for calcite, dolomite, and K feldspar. Pictures of five of the slides are included and descriptions of the types of detrital dolomite given. Depositional interpretations for the formations are given based on the dolomite.—E.S.L.

2541 **Strimple, H. L.; Nassichuk, W. W.** Correlation notes on the upper Wapanucka Limestone of southeastern Oklahoma: Oklahoma Geology Notes, v. 25, no. 11, p. 287–294, illus., 1965.

The Morrowan (Early Pennsylvanian) Wapanucka Formation consists of at least three distinct facies in descending order: white massive oolitic limestone grading into thin-bedded limestone to the northwest; cherty limestone, spicular limestone, and shale in the Ouachita region and limestone and shale in the Arbuckle region; and limestone and shale with two prolific coral and crinoid zones. The upper zone contains the schistoceratid goniatite ammonoid *Axinolobus quinni*, and is correlated with the lower middle part of the Bloyd Formation in northwestern Arkansas and with the Gene Autry Formation in southern Oklahoma. The lower part of the Marble Falls Formation of central Texas is considered Morrowan in age and probably equivalent in part to the Wapanucka. A supplementary description of *A. quinni* McCaleb and Furnish, 1964, is given, based on recently discovered specimens.—V.M.J.

Stuart, C. J. *See* Ehinger, R. F. 2549

Sutherland, Helen L. *See* Haigler, Leon B. 2297

Swanson, Vernon E. *See* Duncan, Donald C. 2322

Swift, Donald J. P. *See* Larrabee, David M. 2446

2336 **Swingle, George D.; Jewell, John W.** Mineral resources summary of the Cardiff quadrangle, Tennessee: Nashville, Tennessee Div. Geology, 16 p., tables, 1965.

This text accompanies Tennessee Div. Geology Geol. Map GM 123 NW (geologic map by H. A. Tiedemann and coal map by J. W. Jewell, cited separately). Coal-bearing rocks underlie all but the extreme southeastern corner of the Cardiff quadrangle, the most important source being the Sewanee seam in the Crab Orchard Mountains Group of the lower Pottsville Series. Tables indicate locations of coal mines and prospects, representative analyses of Sewanee coal, and estimated recoverable coal reserves. All sandstone quarries are on the Cumberland Plateau and are in the upper part of the Rockcastle Conglomerate or in the Crossville Sandstone of the Crooked Fork Group. Sand is being produced by crushing somewhat friable sandstone. Limestone has been quarried, and the Rockwood Formation has been mined and prospected for hematite. Potential resources are shale and chert.—M.C.M.

Swingle, George D. *See* Tiedemann, Herbert A. 2346

Swingle, George D. *See* Luther, Edward T. 2353

2548 **Swingle, George D.; Luther, Edward T.** Geologic map of the Soddy quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 111 SW [sheet 1], scale 1:24,000, separate text, 1964.

The text, "Mineral resources summary of the Soddy quadrangle, Tennessee" by E. T. Luther and G. D. Swingle is cited separately as are the coal maps by Luther and R. E. Hershey.—M.C.M.

Tabor, R. W. *See* Crowder, D. F. 2540

Takahashi, Taro. *See* Bassett, William A. 2526

2308 **Tanner, J. G.; McConnell, R. K.** The gravity anomaly field in the Ungava region of northern Quebec with maps—No. 5, Cape Smith–Povungnituk; No. 6, Wakeham Bay: Dominion Observatory Ottawa Gravity Map Ser., nos. 5–6, 21 p., illus., tables, geol. map, 1964.

Bouguer anomaly patterns, compiled from 614 regional gravity measurements in the Cape Smith–Wakeham Bay area of New Quebec in 1959–60, indicate that the entire area is in a state of isostatic equilibrium. A linear Bouguer anomaly correlates with the basic volcanic and intrusive rocks of the Cape Smith belt, and calculations indicate that the folded basic rocks of the belt are thicker than 20,000 feet. This belt is considered as a load on the crust having a root thickness of about 10,000 feet. A large intrusive body, 20 mi in diameter and extending to 40,000 feet in depth, is suggested by a local positive anomaly in the Payne Bay area. Gravity and geologic maps are in pocket.—V.S.N.

2239 **Tanner, William F.** Marine terraces—Pre-Pleistocene?: Southeastern Geology, v. 6, no. 4, p. 219–222, illus., 1965.

Known marine terraces in the Southeastern States can be plotted on a chart having as ordinates time and elevation. An envelope, drawn through the highest points, indicates that sea level has been dropping since Oligocene times at about 1 mm per 200–300 yr, and that no marine terrace now standing more than about 10 m above present MSL, in the Southeastern States, can have been formed as late as Pleistocene time. This line provides tentative dates for high marine terraces in structurally stable areas.—Author's abstract

2397 **Tarr, Russell S.** Paul J. McIntyre (1894–1963): Tulsa Geol. Soc. Digest, v. 32, p. 26, portrait, 1964.

2303 **Texas Water Development Board.** List of publications: Texas Water Devel. Board Circ. 1, 47 p., 1965.

In September 1965 the Texas Water Commission was divided into the Texas Water Development Board and the Texas Water Rights Commission; prior to February the organization had been named the State Board of Water Engineers. The publication list of the Water Development Board includes all those formerly printed

and distributed by its predecessors, reports of the State Reclamation Department, and Reports and Circulars of the newly created Board. A county and river basin map and an index are included.—M.C.M.

Thomas, M. P. *See* Cushman, R. V. 2440

Thomasson, M. Ray. *See* Thomson, Alan. 2337

2654 **Thompson, Erik; Ripperger, E. A.** An experimental technique for the investigation of the flow of halite and sylvinite, *in* Symposium on rock mechanics, 6th, Rolla, Mo., 1964, Proc.: Rolla, Mo., Univ. Missouri, p. 467–488, illus., 1964.

A technique is presented for modeling mines in materials which flow at relatively low stresses over a long period of time. The model material does not have to be the same as the mine material, and the rate of closure of a mine or cavity of a given size or shape can be determined. Creep tests on sylvanite and halite were conducted, and waxes with similar properties were selected for the models. Six model tests are described and the application to mine design discussed.—E.S.L.

Thompson, G. R. *See* Ehinger, R. F. 2549

2337 **Thomson, Alan; Thomasson, M. Ray.** Sedimentology and stratigraphy of the Dimple Limestone, Marathon region, Texas, *in* The filling of the Marathon geosyncline—Symposium and guidebook, 1964 field trip: Soc. Econ. Paleontologists and Mineralogists Permian Basin Sec. Pub. 64–9, p. 22–30, illus., 1964.

The Dimple Limestone (Early Pennsylvanian) is a sequence of limestones, shales, conglomerates, and cherts, which are referred to shelf, slope, and basin facies. It ranges in thickness from 250 feet (shelf facies) to 905 feet (basin facies). The three facies are described in some detail and shown graphically. Interpretations are summed up and shown in a diagram and paleocurrent map. The Dimple Limestone represents an interruption in the normal terrigenous flysch filling of the geosyncline.—E.S.L.

Thomson, Alan. *See* McBride, Earle F. 2339

2344 **Thomson, Alan.** Applications, *in* The filling of the Marathon geosyncline—Symposium and guidebook, 1964 field trip: Soc. Econ. Paleontologists and Mineralogists Permian Basin Sec. Pub. 64–9, p. 61, 1964.

Applications of the geologic information on the Marathon geosyncline to petroleum exploration are discussed.—E.S.L.

2345 **Thomson, Alan; McBride, Earle F.** Summary of the geologic history of the Marathon geosyncline, *in* The filling of the Marathon geosyncline—Symposium and guidebook, 1964 field trip: Soc. Econ. Paleontologists and Mineralogists Permian Basin Sec. Pub. 64–9, p. 52–60, illus., 1964.

Rocks of the Marathon geosyncline reveal one of the longest unbroken records of sedimentation known, Late Cambrian through Late Pennsylvanian. The tectonic setting, including the type of basin and the large overthrust, is discussed. Only 3,000 feet of sediment accumulated during the forming stage of about 200 million years. The flysch and molasse facies of the filling stage and the formations of the forming stage are described and shown diagrammatically.—E.S.L.

2546 **Thomson, Alan.** Genesis and bathymetric significance of the Caballos Novaculite, Marathon region, Texas, *in* The filling of the Marathon geosyncline—Symposium and guidebook, 1964 field trip: Soc. Econ. Paleontologists and Mineralogists Permian Basin Sec. Pub. 64–9, p. 12–16, illus., 1964.

The Caballos Novaculite is interpreted as a leptogeosynclinal deposit, a thin deep sea deposit representing a long period of geologic time. The silica is believed to be due to abundant sponge spicules and radiolaria. Continuous deposition is indicated from the black cherts below the formation to the terrigenous flysch above. Faunal dates indicate that the Caballos represents at least all of the Silurian and

Devonian and the last of the filling stage of the geosyncline. The calculated rate of deposition is comparable to that of Recent oceanic sediments.—E.S.L.

2293 **Thrailkill, John V.** Karst and cave development in the Rio Camuy area, Puerto Rico [abs.], *in* Internat. Cong. Speleology, 4th, Yugoslavia, 1965, Summ. Lectures: Ljubljana, Yugoslavia, Speleol. Soc. Yugoslavia, p. 60, 1965.

2294 **Thrailkill, John V.** Activity–concentration and relative volume relationships in mischungskorrosion [abs.], *in* Internat. Cong. Speleology, 4th, Yugoslavia, 1965, Summ. Lectures: Ljubljana, Yugoslavia, Speleol. Soc. Yugoslavia, p. 60, 1965.

2346 **Tiedemann, Herbert A.; Jewell, John W.; Swingle, George D.** Geologic map of the Cardiff quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 123–NW [sheet 1], scale 1:24,000, separate text, 1965.

The text, "Mineral resources summary of the Cardiff quadrangle, Tennessee" by G. D. Swingle and J. W. Jewell is cited separately as is the coal map by J. W. Jewell.—M.C.M.

2307 **Tilton, G. R.; Steiger, R. H.** Lead isotopes and the age of the Earth: Science, v. 150, no. 3705, p. 1805–1808, illus., 1965.

Calculations based on comparison of isotopic composition of lead from iron meteorites with that of various modern terrestrial leads have placed the age of the Earth at around 4,550 m.y. However, recent data from young volcanic rocks reveal that modern terrestrial lead can have a wide range in isotopic composition. The variations in its composition mean that one or more of the assumptions used in the age calculation have been violated. We modified the usual approach by comparing meteorite lead with lead from rocks 2,700 m.y. old, from the Canadian Shield. Using this method and the same constants and assumptions utilized in the earlier calculations we calculated an age of 4,750±50 m.y. for the Earth. The Earth may be approximately 200 m.y. older than previously thought; alternatively, primordial terrestrial lead may not have had the same isotopic composition as lead in iron meteorites does.—Authors' abstract

Tilton, G. R. *See* Wetherill, G. W. 2453

2630 **Tilton, G. R.** Compilation of Phanerozoic geochronological data for Eastern North America, *in* Geochronology of North America: Natl. Acad. Sci.—Natl. Research Council Nuclear Sci. Ser. Rept. 41 (NAS–NRC Pub. 1276), p. 181–220, tables, 1965.

Absolute age data are tabulated for rocks of Phanerozoic age from Newfoundland, Quebec, New Brunswick, Nova Scotia, the New England States, New York, New Jersey, Pennsylvania, Maryland, District of Columbia, Virginia, North Carolina, South Carolina, Georgia, Tennessee, and Alabama.—V.S.N.

Toler, L. G. *See* Musgrove, R. H. 2477

2582 **Toler, L. G.** Use of specific conductance to distinguish two base–flow components in Econfina Creek, Florida, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525–C, p. C206–C208, illus., 1965.

The base flow of Econfina Creek in northwestern Florida is provided by ground–water discharge from surficial deposits of sand and from limestone of the artesian Floridan aquifer. After computation of the proportion of the base flow provided by each aquifer, by use of average values of the specific conductance of spring water and stream water, the discharge from each aquifer was calculated by applying these proportions of the stream–discharge data. The discharge of the artesian spring varies directly with the levels of lakes, in the basin of a nearby stream, which are believed in part to recharge the Floridan aquifer.—Author's abstract

2583 **Toler, L. G.** Relation between chemical quality and water discharge in Spring Creek, southwestern Georgia, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525–C, p. C209–C213, illus., 1965.

A cyclical relation between water discharge and the concentration of dissolved solids has been found in Spring Creek, in southwestern Georgia. This form of cyclical change is attributed to the greater influence of ground-water during the falling stage. The greater influence of ground-water discharge is believed to result from an increase in ground-water flow to streams in an area where ground-water levels respond rapidly to rainfall and where good hydraulic connection exists between the aquifer and the streams.—W.L.G.

2613 **Toomey, Donald Francis.** Ellenburger (Lower Ordovician) sponge beds of central Texas, *in* Symposium on the Arbuckle: Tulsa Geol. Soc. Digest, v. 32, p. 98–111, illus., 1964.

Prominent sponge horizons crop out in the Honeycut and Gorman Formations of the Llano region. These outcrops have been examined, and their petrology and faunal content studied. It is believed that most of the Ellenburger sponges, principally *Archaeoscyphia* are not indigenous to the rocks in which they occur. It is thought that they grew in shallow water some distance from shore, where at times vigorous waves or currents ripped them up and they were carried in and deposited along the shoreline.—*from* Author's abstract

Tou, J. C.-M. *See* Schwerdtner, W. M. 2451

2306 **Toulmin, Stephen; Goodfield, June.** The discovery of time: New York and Evanston, Harper and Row, 280 p., illus., 1965.

This book, the third in a four volume series on the "ancestry of science", discusses the emergence of a continuing sense of history out of mythological and theological systems. The closeness of the parallel development of man's historical consciousness in physical cosmology with theology and social history, and the recurrent patterns of theory manifested in all historical sciences (of man or of nature) are demonstrated. The eleven chapter headings are as follows: memories and myths, science without history, the authority of the scriptures, the revival of natural philosophy, the revival of civil history, time's creative hand, the Earth acquires a history, background to Darwin, life acquires a genealogy, history and the human sciences, and time and the physical world.—V.S.N.

2580 **Tourtelot, H. A.; Frost, I. C.** Extractable organic material in nonmarine and marine shales of Cretaceous age, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525–D, p. D73–D81, illus., table, 1965.

Organic material extracted from 5 samples of nonmarine carbonaceous shale, 10 samples of marine black shale, and 3 samples of marine marlstone, all from the Pierre Shale and equivalent stratigraphic units of Late Cretaceous age, was separated with activated silica gel and solvents into fractions interpreted as saturated hydrocarbons, aromatic hydrocarbons, and nonhydrocarbons. . . . Data on extractable material do not distinguish between shale and marlstone of marine and nonmarine origin. Comparison of the data on the samples of Cretaceous age with published data on samples of a wide range of ages and geologic histories suggests that post-depositional reactions increase the proportion of saturated and aromatic hydrocarbons compared to nonhydrocarbons.—Authors' abstract

2683 **Trainer, Frank W.; Waller, Roger M.** Subsurface stratigraphy of glacial drift at Anchorage, Alaska, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525–D, p. D167–D174, illus., 1965.

Pleistocene deposits at Anchorage, in south-central Alaska, represent at least five episodes of glaciation and include all the types of sediments commonly found in glacial drift. The stratigraphy of the drift is described in this report, and the areal distribution of the separate units is outlined.—Authors' introduction

Tsong, C. F. *See* Keen, M. J. 2463

Tsong, C. F. *See* Keen, M. J. 2464

2479 **Tufford, Sarah; Hogberg, Rudolph.** Guide to fossil collecting in Minnesota: Minnesota Geol. Survey Educ. Ser. 1, 30 p., illus., geol. map, 1965.

After a brief definition of fossils, and a discussion of their geologic history in Minnesota, types to be found are described. Drawings accompany the descriptions, and the formations in which they occur are given. A bedrock geologic map of southern Minnesota is included.—E.S.L.

2275 **Turcotte, Frederick Thomas.** Epicenters and focal depths in the Hollister region of central California [abs.]: Dissert. Abs., v. 25, no. 10, p. 5870, 1965.

Turner, F. J. *See* Heard, H. C. 2538

Tuttle, C. R. *See* Oldale, R. N. 2567

2575 **Uchupi, Elazar.** Basins of the Gulf of Maine, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-D, p. D175-D177, illus., table, 1965.

Closed depressions occupy about 30 percent of the floor of the Gulf of Maine and contain about 8 percent of the water in the gulf. In 21 of these depressions the area at sill level ranges from 27 to 10,400 sq km, and the basin floor lies 5–135 m below the sills, or 64–377 m below sea level. The closed character of the depressions, the lack of seaward gradients, and the presence of sediments similar to glacial drift suggest that glacial erosion and deposition have played significant roles in formation of the present topography of the floor of the Gulf of Maine.—Author's abstract

Udd, J. E. *See* Nair, O. B. 2642

2149 **Upshaw, Charles F.; Creath, Wilgus B.** Pennsylvanian miospores from a cave deposit in Devonian limestone, Callaway County, Missouri: Micropaleontology, v. 11, no. 4, p. 431–448, illus., tables, 1965.

Sixty-nine miospore taxa are reported from a Pennsylvanian cavern deposit enclosed within the Middle Devonian Callaway Limestone. Four species, *Lophotriletes cursus*, *Lophotriletes trilobus*, *Pustulatisporites vegrandis*, and *Ahrensisporites subtilis*, are new. The assemblage is interpreted to indicate a probable Desmoinesian (lower Cygnian) age for the deposit. Spores of the Lycopsida are quantitatively dominant and those of the Filicineae, Gymnospermae and Sphenopsida are present in smaller numbers.—Authors' abstract

2443 **U.S. Geological Survey.** (Systematic Literature Research Unit). Bibliography of North American geology, 1961: U.S. Geol. Survey Bull. 1197, 663 p., 1965.

2245 **Utgaard, John; Perry, T. G.** Trepostomatous bryozoan fauna of the upper part of the Whitewater Formation (Cincinnatian) of eastern Indiana and western Ohio: Indiana Geol. Survey Bull. 33, 111 p., illus., tables, 1964.

The Elkhorn Formation does not appear to be a distinct stratigraphic unit and the authors propose that it be abandoned, and the upper part of the Whitewater be used to include these beds. Thirty-five bryozoan species including nine new ones were found; the most common are discussed, and statistical summaries of measurements of significant taxonomic characters are included.—E.S.L.

2539 **Vaasjoki, O.** A diopside from the Nordre Strömfjord area, West Greenland: Finlande Comm. Géol. Bull. 215, p. 163–169, tables, 1964.

The petrography and paragenetic properties of two samples collected from Precambrian dike-like occurrences are described. One of the samples is characterized by the association diopside-spinel-anorthite, the other by pinkish mica, carbonaceous material, and diopside. Optical and X-ray powder data, and chemical analyses for the diopside in sample 1 are tabulated and compared with others. Inferences are drawn as to the origin of the dikes.—E.S.L.

2334 **Vacquier, V.** Transcurrent faulting in the ocean floor, *in* A symposium on continental drift: Royal Soc. London Philos. Trans., ser. A, v. 258, no. 1088, p. 77–81, illus., 1965.

Strike-slip displacements along the ocean floor can be measured by fitting magnetic anomaly patterns. Combined left lateral displacement of 1,400 km across the Mendocino and Pioneer faults can be followed over 2,200 km in the northeastern Pacific. Right lateral displacements of 150 and 680 km separated by a disturbed zone have been measured on the Murray fault. Fourteen magnetic profiles across the Mid-Atlantic Ridge show a persistent anomaly on the ridge crust which is more continuous than topographic features; its position suggests that if the ridge was originally continuous, it has now been cut into sections by strike-slip faults.—D.B.V.

2579 **VanAlstine, Ralph E.** Geochemical prospecting in the Browns Canyon fluorspar district, Chaffee County, Colorado, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-D, p. D59-D64, illus., tables, geol. map, 1965.

In the Browns Canyon district, geochemical prospecting investigations revealed abnormal fluorine concentrations in residual soil directly above and downslope from a fluorspar vein, and in alluvium downstream from the vein. The largest anomalies are approximately 6 to 20 times the background in the soil and 3 times the background in the alluvium. Fluorine contents of soil near a concealed fault are too low to suggest the presence of an underlying fluorspar deposit. Although geochemical prospecting methods have been reported as not especially suited for locating fluorspar deposits directly, fluorine actually can be a favorable indicator element for this purpose.—Author's abstract

2640 **VanDenburgh, A. S.** Chemical distinction between ground water of four sedimentary units on the Kitsap Peninsula and adjacent islands, Washington, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-D, p. D219-D221, illus., table, 1965.

The analysis of 37 ground-water samples from the Kitsap Peninsula and adjacent islands in Puget Sound, Wash., as part of an evaluation of the water resources of the area, has allowed definition of the characteristic chemical qualities of water from the several principal productive rock formations in the area. An accompanying table summarizes the character of the water-bearing deposits.—Author's introduction

2493 **VanHouten, F. B.** Composition of Triassic Lockatong and associated formations of Newark Group, central New Jersey and adjacent Pennsylvania: Am. Jour. Sci., v. 263, no. 10, p. 825-863, illus., tables, geol. map, 1965.

Nonmarine intermontane deposits of the Triassic Newark Group accumulated under conditions of cyclic variation in rainfall imposed on a subsiding lake basin. Accompanying variations in Eh, pH, and salinity are recorded in cyclic repetition of facies. Lockatong lacustrine deposits occur in detrital and chemical cycles averaging 15 feet thick. When increasing rainfall generated through-flowing drainage, Lockatong deposits reverted to a Stockton-like detrital facies; during drier phases gray red chemical cycles accumulated in a shallow closed lake which eventually gave way to oxidizing Brunswick mud flats. Unusually high sodium content reflects greater abundance of Na-feldspar than of K-feldspar in detrital rocks and the occurrence of authigenic albite and analcime in the Lockatong chemical cycles.—E.W.W.

2205 **vanRensburg, Willem C. J.; Cameron, Eugene N.** Additional data on rotation properties of ore minerals, [Pt.] 2: Econ. Geology, v. 60, no. 8, p. 1718-1720, table, 1965.

"Data for 20 minerals are given, supplementing data for 120 minerals previously published."

2320 **Varnedoe, William W., Jr.** A hypothesis for the formation of rimstone dams and gours: Natl. Speleol. Soc. Bull., v. 27, no. 4, p. 151-152, 1965.

Rimstone dams, found in hot springs and cave streams, grow vertically, have horizontal top edges, and are oriented at right angles to stream flow. Supersaturation in the depositing waters is a prerequisite for formation. The author's hypothesis is that an increase in velocity over an obstruction causes a decrease in internal pressure and degassing of the solution, resulting in the buildup of dams.—E.S.L.

Vecchioli, John. *See* Gill, Harold E. 2543

2494 **Velde, B.** Phengite micas—Synthesis, stability, and natural occurrence: Am. Jour. Sci., v. 263, no. 10, p. 886–913, illus., tables, 1965.

The stability field of synthetic micas is restricted to muscovite-rich phengites, and is most extensive along the muscovite MgAl-celadonite join and to a lesser extent along the $MgFe^{+3}$-celadonite join. Experimental stabilities and considerations of cell volume in phengite reactions indicate that the range of solid solution increases with total pressure where P_{water} equals or almost equals P_{total} and is restricted with increasing temperature. Natural phengites define a greater solid solution field than do synthetics, but both natural and synthetic dioctahedral micas fall into two well-defined groups, Fe^{+3}-poor phengites and Fe^{+3}-bearing glauconite celadonite. Natural phengite forms in retrograde and prograde metamorphic rocks and indicates conditions of high pressure and relatively low temperature.—R.W.T.

2508 **Veysman, J. I.** Poligonal'no-zhil'nyy led Alyaski i sopredel'noy territorii Kanady, *in* Podzemnyy led; Moscow, Moscow University Press, p. 51–86, illus., 1965.

Ice wedges, patterned ground, and other features of permafrost in Alaska and the adjacent territories of Canada are reviewed from the literature. A list of 54 references, for the most part in English, is included.—V.S.N.

2276 **Virgin, William Wallace, Jr.** The structure and petrography of the Concord granite in the Concord area, New Hampshire [abs.]: Dissert. Abs., v. 25, no. 10, p. 5870–5871, 1965.

2651 **Waddell, Galen G.** Application of instrumentation in determining rock behavior during stoping at the Star mine, Burke, Idaho, *in* Symposium on rock mechanics, 6th, Rolla, Mo., 1964, Proc.: Rolla, Mo., Univ. Missouri, p. 23–42, illus., 1964.

Dilation and contraction of the rock surrounding horizontal access openings of a deep mine were analyzed during stope advance to determine what type of measurements, made with inexpensive instrumentation, would best reflect the rock behavior. A variety of instruments, mostly mechanical extensometers, were used. Although all of the radial-deformation rate graphs illustrated useful rock behavior data, the most informative graphs were compiled from data procured with the radial extensometers that penetrated, to various depths, the rock around the access openings. This information could be of particular value in determining how underground openings should be supported.—Author's abstract

2692 **Wait, Robert L.** Geology and occurrence of fresh and brackish ground water in Glynn County, Georgia: U.S. Geol. Survey Water-Supply Paper 1613-E, p. E1–E94, illus., tables, 1965.

Test drilling and water sampling in Glynn County, Ga., have shown that fresh water underlies the Brunswick Peninsula at depths from about 500 to 1,000 feet in limestones of late Eocene to Miocene age. At greater depths a zone of brackish water occurs; these waters are currently contaminating municipal and industrial wells in the County. All brackish water is connate water. Abundant ground water is available in Glynn County, but more detailed knowledge about the occurrence of this brackish water and the coefficients of storage and transmissibility is needed.—W.L.G.

2296 **Walker, George W.; Repenning, Charles A.** Reconnaissance geologic map of the Adel quadrangle, Lake, Harney, and Malheur Counties, Oregon: U.S. Geol. Survey Misc. Geol. Inv. Map I-446, scale 1:250,000, sections, 1965.

The map sheet includes a list of fossil localities, references cited, and a tectonic sketch map.—M.C.M.

2398 **Walker, Lucian A.** James H. Gardner (1883–1964): Tulsa Geol. Soc. Digest, v. 32, p. 27, portrait, 1964.

2363 **Wallace, Norman.** The Billings field, Noble County, Oklahoma, *in* Symposium on the Arbuckle: Tulsa Geol. Soc. Digest, v. 32, p. 152–155, illus., 1964.

The brief geologic interpretation and description are accompanied by a cross section and structure contour map.—E.S.L.

2364 **Waller, R. K.; Brewer, John.** The Tobias field, Rice County, Kansas, *in* Symposium on the Arbuckle: Tulsa Geol. Soc. Digest, v. 32, p. 156–157, illus., 1964.

The paper consists of a structure contour map and a brief description of the field.—E.S.L.

Waller, Roger M. *See* Trainer, Frank W. 2683

2390 **Walters, Kenneth L.** Mashel Formation of southwestern Pierce County, Washington, *in* Changes in stratigraphic nomenclature by the U.S. Geological Survey, 1964: U.S. Geol. Survey Bull. 1224-A, p. A55–A59, illus., table, 1965.

Walters, Kenneth L. *See* Bingham, James W. 2609

2478 **Ward, Dederick C.** (compiler). Bibliography of theses in geology, 1964: Geoscience Abs., v. 7, no. 12, pt. 1, spec. supp., p. 101–137, 1965.

This supplement is a record of 682 theses prepared for master's or doctor's degrees in geology, most of which were completed in 1964. Listings are alphabetical by author and include the author's name, degree, date, university, and title of thesis. Included also are an index of geologic names and a general geographical and subject index. The bibliography supplements data given in "Bibliography of Theses in Geology" and "Bibliography of Theses in Geology, 1958–1963", both compiled by John and Halka Chronic and issued by A.G.I. in 1958 and 1964, respectively.—M.C.

2456 **Washburn, A. L.** Memorial to John Danvers Bateman (1910–1965): Geol. Soc. America Bull., v. 76, no. 10, p. P149–P151, portrait, 1965.

2139 **Watson, Richard A.; Smith, Philip M.** The Flint Ridge Cave Research Center, Mammoth Cave National Park, Kentucky [abs.], *in* Internat. Cong. Speleology, 4th, Yugoslavia, 1965, Summ. Lectures: Ljubljana, Yugoslavia, Speleol. Soc. Yugoslavia, p. 63, 1965.

2295 **Watson, Richard A.** Big canyons in the central Kentucky karst [abs.], *in* Internat. Cong. Speleology, 4th, Yugoslavia, 1965, Summ. Lectures: Ljubljana, Yugoslavia, Speleol. Soc. Yugoslavia, p. 62–63, 1965.

2268 **Webb, S. David.** The osteology of *Camelops*: Los Angeles County Mus. Bull., Sci. no. 1, 54 p., illus., tables, 1965.

Camelops Leidy 1854 can be recognized as a distinct camelid genus in the Pleistocene of North America. Detailed study of the osteology, especially the cranium, of *C. hesternus*, from Rancho La Brea, Calif., demonstrates close affinity of *Camelops* to the South American *Lama* and a much more distant relation to *Camelus* of Eurasia. Diagnoses of *Camelops* and other North American Pleistocene genera, *Tanupolama* and *Titanotylopus*, are presented, and relationships with Pliocene genera are discussed. Of the subfamily Camelidae, the tribes Camelopini (*Camelops* and its Pliocene ancestor *Megatylopus*) and Lamini (*Tanupolama, Lama*, and others) are closely related, though separate since the Barstovian. The Camelini, including *Titanotylopus*, form a distinct group. *Megatylopus matthewi* n. sp. is described from the middle Pliocene of Hemphill County, Texas.—V.M.J.

2408 **Weeks, Warren B.** The future of petroleum geologists in the United States [abs.]: Tulsa Geol. Soc. Digest, v. 32, p. 166–167, 1964.

2264 **Weidman, Robert M.** The Montana lineament, *in* Geology of the Flint Creek Range, Montana—Billings Geol. Soc., 16th Ann. Field Conf. 1965: Billings, Mont., Billings Geol. Soc., p. 137–143, illus., 1965.

This paper summarizes from the literature the nomenclature, descriptive geology, and some interpretations of the Montana lineament, a feature extending at least 200 miles east-southeast from the Coeur d'Alene district. It appears to indicate the presence of a deep-seated zone of tectonic weakness.—E.S.L.

2373 **Weir, James E., Jr.** Geology and availability of ground water in the northern part of the White Sands Missile Range and vicinity, New Mexico: U.S. Geol. Survey Water-Supply Paper 1801, 78 p., illus., tables, 1965.

The geology and ground-water resources of the northern part of the White Sands Missile Range and vicinity in south-central New Mexico are described. Rocks ranging in age from Precambrian to Quaternary crop out in fault-block mountains and in the adjacent desert basins; Silurian and Jurassic rocks are not represented in the sequence. Chief aquifers are unconsolidated rocks of Tertiary and Quaternary age. The chemical quality of the water is generally poor, being high in sulfate or in sulfate plus chloride. Geologic and water-table maps, and selected well data and chemical analyses are included.—W.L.G.

2590 **Weis, Paul L.; Richmond, Gerald M.** Maximum extent of late Pleistocene Cordilleran glaciation in northeastern Washington and northern Idaho, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-C, p. C128–C132, illus., 1965.

Late Pleistocene glaciers in northeastern Washington and northern Idaho were considerably less extensive than has been previously supposed. Ice which was part of a single large sheet farther north formed a number of lobes that were for the most part valley glaciers near their southern margins. Ice-contact deposits, landforms, and ice-modified bedrock were used as criteria for determining the outermost position of the ice margins. Deposits south of those margins that were once considered to be till are now thought to have formed as a result of the catastrophic floods from glacial Lake Missoula.—Authors' abstract

Weiss, L. E. *See* Heard, H. C. 2538

2536 **Weist, W. G., Jr.** Geohydrology of the Dateland-Hyder area, Maricopa and Yuma Counties, Arizona: Arizona Land Dept. Water Resources Rept. 23, 46 p., illus., tables, 1965.

Valley fill is the only water-bearing unit in the area. Bedrock is composed of granite, schist, and volcanic rocks, mostly lava. It is estimated that the first 100 feet of saturated material contains about 5,000,000 acre-feet of available ground water; in general, water levels in the area are slowly declining. Chemical analyses of 27 water samples from wells show that the water is sodium chloride type. It is acceptable for domestic and stock purposes, although fluoride content is high, and can be used for irrigation if proper practices are followed.—*from* Author's abstract

2251 **West Texas Geological Society.** Geology of the Big Bend area, Texas—Field trip guidebook, with road logs and papers on natural history of the area: West Texas Geol. Soc. Pub. 65-51, 196 p., illus., tables, geol. maps, 1965.

A summary of the geology, and the Cenozoic history of the area are given. Papers also include the Paleozoic of the Solitario and Santiago Mountains. There are ten road logs for three days of field trips.—E.S.L.

West, Walter S. *See* Cohee, George V. 2392

2453 **Wetherill, G. W.; Bickford, M. E.; Silver, L. T.; Tilton, G. R.** Geochronology of North America: Natl. Acad. Sci.—Natl. Research Council Nuclear Sci. Ser. Rept. 41 (NAS–NRC Pub. 1276), 315 p., illus., tables, 1965.

Compilations of absolute age data for the North American continent are presented in separate tables for the Precambrian and Phanerozoic of eastern and western North America. Introductory chapters discuss the present status of geochronological methods and introduce the compilations of data. A list of 144 references from which compilations were made and a map showing locations of data samples and age ranges are included.—V.S.N.

Wetherill, G. W. *See* Bickford, M. E. 2454

2323 **White, Donald E.** Geothermal energy: U.S. Geol. Survey Circ. 519, 17 p., table, 1965.

In areas of "normal" geothermal gradient heat content of rocks is an extremely low-grade source of energy. Recovery of stored heat from large regions of volcanic and tectonic activity may be economically feasible in the future. Hot-spring areas of the world are tabulated to indicate approximate size, maximum recorded temperature, and total heat flow. The Salton Sea, Calif., and Larderello, Italy, geothermal areas, characterized by low natural rates of discharge of water or steam at the surface, are examples of hydrothermal systems of composite type, in which temperatures increase rather steadily with depth. Present world utilization of geothermal energy probably can be increased 10–100 times for at least the next 50 years. Probably 5–10 percent of the total world resources occurs in the United States, the highest potential area being in the western states.—M.C.M.

2138 **White, William B.** Sulfate mineralogy in some caves in the United States [abs.], *in* Internat. Cong. Speleology, 4th, Yugoslavia, 1965, Summ. Lectures: Ljubljana, Yugoslavia, Speleol. Soc. Yugoslavia, p. 63–64, 1965.

2140 **White, William B.; Stellmack, John A.** Seasonal fluctuations in the chemistry of karst groundwater [abs.], *in* Internat. Cong. Speleology, 4th, Yugoslavia, 1965, Summ. Lectures: Ljubljana, Yugoslavia, Speleol. Soc. Yugoslavia, p. 64, 1965.

Whiteway, F. E. *See* Birtill, J. W. 2532

2165 **Wilcox, John Thomas.** The Grants Ridge uranium area, New Mexico [abs.]: Dissert. Abs., v. 25, no. 12, pt. 1, p. 7207, 1965.

2516 **Willden, Ronald.** Seismic-refraction measurements of crustal structure between American Falls Reservoir, Idaho, and Flaming Gorge Reservoir, Utah, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-C, p. C44–C50, illus., tables, 1965.

Interpretation of a reversed seismic-refraction profile indicates a thickening of the crust from about 31 km at American Falls Reservoir to about 37 km at Flaming Gorge Reservoir. The velocity of compressional waves in the mantle just beneath the M-discontinuity is about 7.8 kmps; in the intermediate layer, about 6.9 kmps; and in the upper crust about 5.9 kmps. A prominent phase with an apparent velocity of 8.4 kmps, recorded at distances of 210 to 325 km from American Falls Reservoir, is believed to be a reflection from a boundary within the mantle.—W.L.G.

2195 **Williams, K. L.** Determination of the iron content of sphalerite: Econ. Geology, v. 60, no. 8, p. 1740–1747, illus., 1965.

X-ray diffraction analysis, particularly of natural sphalerites, does not yield the precision commonly attributed to the method. X-ray fluorescence spectrometry and wet chemical methods yield average values for inhomogeneous samples. Electron-probe microanalysis is favored over other methods where refined information is sought, particularly with inhomogeneous material.—W.S.W.

Wilshire, Howard G. *See* Seeland, David A. 2315

2312 **Wilson, J. Tuzo.** Evidence from ocean islands suggesting movement in the Earth, *in* A symposium on continental drift: Royal Soc. London Philos. Trans., ser. A, v. 258, no. 1088, p. 145–167, illus., tables, 1965.

Oceanic islands increase in age from the mid-ocean ridges toward continents and the andesite line. The Seychelles appear to be a continental fragment. Pairs of aseismic ridges extend from islands on the mid-ocean ridges to adjacent continents. One possible explanation is that convection currents rising along mid-ocean ridges and sinking beneath trenches have carried the crust apart across the Atlantic, Indian, and East Pacific Oceans; the lateral ridges may be approximately streamlines. Volcanic islands that have been uplifted rather than sunk may be on the crest of a standing wave of rigid crust in front of the trenches. Straight chains of islands in the Pacific could also be streamlines.—D.B.V.

2249 **Wilson, James Lee.** Older Paleozoic stratigraphy in the Solitario, *in* Geology of the Big Bend area, Texas—Field trip guidebook: West Texas Geol. Soc. Pub. 65–51, p. 37–38, illus., geol. map, 1965.

The older Paleozoic sequences of the Solitario and Marathon areas are compared. They are significant to the interpretation of sedimentary and tectonic history in western Texas and northern Mexico. The Solitario dome exposes a part of the Marathon–Ouachita fold belt a little farther into the geosyncline than the Marathon uplift. A cross section showing Ordovician facies across Marathon folds and a geologic map of the Solitario basin accompany the paper.—E.S.L.

2267 **Wilson, John A.** Cenozoic history of the Big Bend area, West Texas, *in* Geology of the Big Bend area, Texas—Field trip guidebook: West Texas Geol. Soc. Pub. 65–51, p. 34–36, illus., table, 1965.

Paleocene to Miocene formations and their associated mammalian faunas are described. Datable events during the Tertiary are summarized.—E.S.L.

Wilson, M. T. *See* Hahl, D. C. 2682

Winslow, John D. *See* Broeker, Margaret E. 2483

2520 **Witkind, Irving J.** Relation of laccolithic intrusion to faulting in the northern part of the Barker quadrangle, Little Belt Mountains, Montana, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-C, p. C20–C24, illus., 1965.

Three anticlines, underlain by laccoliths, are radial to a central stock and are bounded, in part, by normal faults dipping 50° to 60° away from the laccoliths. These faults increase in throw toward the stock. Three separate mechanisms of laccolithic emplacement can be inferred, depending upon: (1) whether the stock or, alternatively, a deeper chamber are considered to have been the source of the magma, and (2) whether the bounding faults that apparently confined the lateral spread of parts of the laccoliths grew out of stresses related to the emplacement of the central stock or, alternatively, of the laccoliths themselves.—Author's abstract

Wong, W. W. *See* DeLory, F. A. 2495

2198 **Wood, Albert E.** Small rodents from the early Eocene Lysite Member, Wind River Formation of Wyoming: Jour. Paleontology, v. 39, no. 1, p. 124–134, illus., 1965.

Study of the small rodents from the type area of the Lysite Member, Wind River Formation, Wyoming, shows that at least four species are present. Small paramyids are referred to *Microparamys lysitensis* and *Lophiparamys debequensis*. Sciuravids are referred to *Knightomys depressus* and *Dawsonomys minor* n. sp. The former is perhaps close to being ancestral to all the other members of the Sciuravidae. The very close relationships between Paramyidae and Sciuravidae during Lysite time indicate that the two families had just diverged.—F.C.W.

2246 **Woodford, A. O.** Historical geology: San Francisco, W. H. Freeman and Co., 512 p., illus., tables, 1965.

This introductory textbook concentrates on the major discoveries in the field of geologic history. Two chapters cover specific areas, the Grand Canyon platform–Cordilleran geosyncline and the platform and geosyncline in east-central North America. Correlation by fossils and radiometric dating are discussed in two chapters. The chapters devoted to a study by periods stress evolution and include a worldwide survey of the Precambrian. One chapter is devoted to Gondwanaland, including the whole problem of paleomagnetism and continental drift. The final chapter covers the Pleistocene. Appendixes give more detail on fossil classification and recognition, and Triassic–Cretaceous zones and stages.—E.S.L.

2534 **Worzel, J. L.** Discussion [of physics of convection currents in the Earth's mantle], *in* A symposium on continental drift: Royal Soc. London Philos. Trans., ser. A, v. 258, no. 1088, p. 275, 1965.

The satellite geoid referred to by Runcorn and by O'Keefe in this symposium (p. 228–251 and 272–275, respectively) shows a deep depression in the eastern North Pacific which is not shown by pendulum measurements at sea; it must be considered that the satellite data may be in error.—D.B.V.

2673 **Wright, Harold D.; Barnard, Walter M.; Halbig, Joseph B.** Solid solution in the systems ZnS–ZnSe and PbS–PbSe at 300°C and above: Am. Mineralogist, v. 50, no. 10, p. 1802–1815, illus., tables, 1965.

Complete solid solution was found in both systems at 300°C and in ZnS–ZnSe down to at least 160°C. All runs produced a single crystalline phase and well formed crystals of the solid solutions were obtained in sizes to one mm. Use of partition coefficients of Se between sphalerite and galena is discussed.—E.H.R.

2277 **Wright, Jerome J.** Petrology of the Devonian rocks in eastern Pima and Cochise Counties, Arizona [abs.]: Dissert. Abs., v. 25, no. 10, p. 5871, 1965.

2166 **Wright, Ramil Carter.** Foraminiferal ecology in a back-reef environment, Molasses Reef, Florida [abs.]: Dissert. Abs., v. 25, no. 12, pt. 1, p. 7207, 1965.

2578 **Wrucke, Chester T.** Prehnite and hydrogarnet(?) in Precambrian rocks near Boulder, Colorado, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525–D, p. D55–D58, illus., 1965.

Prehnite and a hydrogarnet(?) occur as accessory minerals in several rocks of Precambrian age that crop out near Boulder, Colo. The principal host for these minerals is the Boulder Creek batholith, but gabbroic and dioritic masses intruded by the batholith also contain them. Both minerals form small lens-shaped masses in biotite. Prehnite is interpreted as having crystallized from CaO-rich deuteric solutions that originated in the Boulder Creek batholith, but a metamorphic origin is possible. The hydrogarnet(?) may have formed from the prehnite later in the deuteric period.—Author's abstract

2439 **Young, L. L.; Colbert, J. L.; Gaskill, D. L.; Piper, A. M.** Waterpower resources in Nehalem River basin, Oregon, *with sections on* Geology of sites: U.S. Geol. Survey Water-Supply Paper 1610–C, p. C1–C58, illus., tables, geol. maps, 1965.

The potential waterpower of the Nehalem River is estimated on the basis of the streamflow for the period 1940–54 with complete development within the basin or with diversion of some water to the Columbia River. The Nehalem River has numerous natural storage sites for regulating flow, and preliminary examinations of the geology and its relation to possible dam and reservoir sites in these areas, indicates that the sites are geologically feasible.—W.L.G.

2631 **Zapp, Alfred D.; Clark, Lorin D.** Bauxite in areas adjacent to and between the Springvale and Andersonville districts, Georgia: U.S. Geol. Survey Bull. 1199–H, p. H1–H10, illus., geol. map, 1965.

Scattered small deposits of low-grade bauxite and bauxitic clay of little potential economic importance occur in a strip that extends northeastward between and beyond the Springvale and Andersonville bauxite districts. The bauxite occurs

within kaolin bodies in continental beds of the Nanafalia Formation (early Eocene), which is overlain by marine sands and clays of the Tuscahoma Formation (early Eocene) and underlain by the Midway Group (Paleocene). The stratigraphy of the area is characterized by northward and eastward thinning of the Tuscahoma Formation and the Midway Group. As the entire strip was covered by overlapping sands of middle Eocene age and limestones of late Eocene and Oligocene ages, the lower Eocene and Paleocene beds are exposed only in the stream valleys:—*from* Authors' abstract

2672 **Zartman, Robert; Snyder, George; Stern, Thomas W.; Marvin, Richard F.; Bucknam, Robert C.** Implications of new radiometric ages in eastern Connecticut and Massachusetts, *in* Geological Survey Research 1965: U.S. Geol. Survey Prof. Paper 525-D, p. D1–D10, illus., tables, 1965.

New Rb-Sr, K-Ar, U-Th-Pb, and Pb-α radiometric ages are presented for granitic and pegmatitic rocks and minerals from eastern Connecticut and Massachusetts. Synthesis of data with field geology indicates that, in eastern Connecticut: Tatnic Hill Formation is probably Middle Ordovician; Scotland Schist and Hebron Formation are Early Devonian or older; Canterbury Gneiss, and Lebanon gabbro were intruded during the Acadian orogeny in Early Devonian; older pegmatites have been intruded over a span ranging from possibly Middle Ordovician to Middle Devonian; the area was regionally dynamothermally metamorphosed in Acadian and thermally remetamorphosed in Alleghenian orogenies; and younger pegmatites were intruded in Permian. In eastern Massachusetts, Ayer Granite at Millstone Hill was intruded in Late Devonian or Early Mississippian time.—*from* Authors' abstract

Zeisloft, Jon. *See* Strickler, Bill. 2258

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